

Feeling **HOT HOT HOT**:  
Assessing the Health Risks  
and Response Opportunities  
Under Climate Change

Dr. Quentin Chiotti  
Senior Scientist on Climate Change  
Pollution Probe



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## **The Relative Magnitude of the Impacts and Effects of GHG-Related Emission Reductions**

Prepared for Environment Canada/  
Environnement Canada (1999)

Quentin Chiotti, Pollution Probe  
Natty Urquizo, Rainmakers  
Environmental Group

[www.msc.ec.gc.ca/saib/atmch\\_e.cfm](http://www.msc.ec.gc.ca/saib/atmch_e.cfm)  
[www.pollutionprobe.org](http://www.pollutionprobe.org)



## **Towards an Adaptation Action Plan: Climate Change and Health in the Toronto-Niagara Region (Chiotti, Q., Morton, I., Maarouf, A., Kelleher, M. and K. Ogilvie; 2002)**

Funded through the Government of Canada's Climate Change Action Fund, prepared by the Pollution Probe Foundation, in partnership with Environment Canada and Health Canada

(City of Toronto, City of Mississauga and the Region of Peel, University of Toronto, Ontario College of Family Physicians)

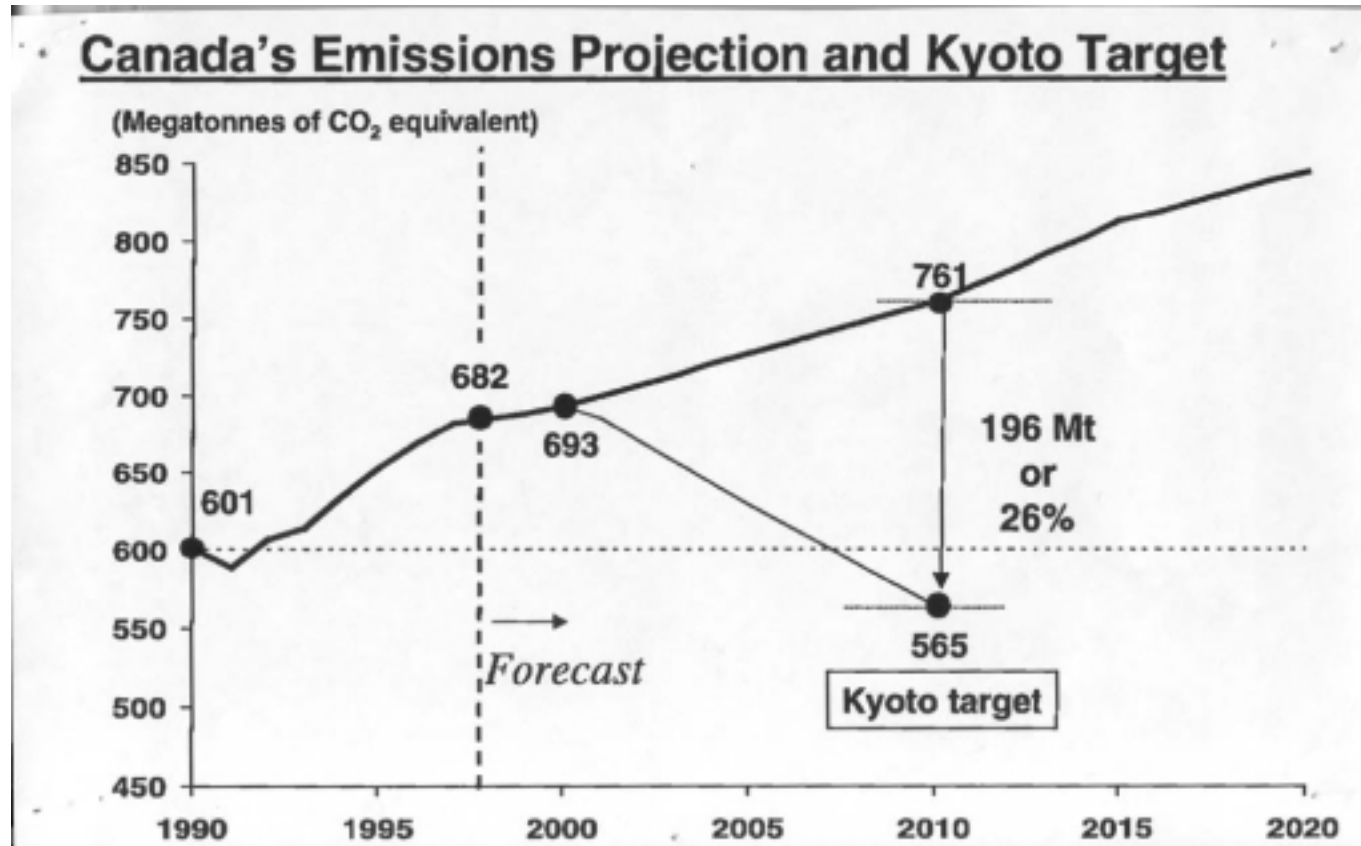
[www.pollutionprobe.org](http://www.pollutionprobe.org)  
<http://adaptation.nrcan.gc.ca/>

# Two Key Questions:

1. How will the heat-related health risks be affected by climate change?
2. What are the co-benefits for environment and health from actions that are aimed at reducing the urban heat island effect and minimizing associated health effects?



# Kyoto Protocol - Canadian Challenge

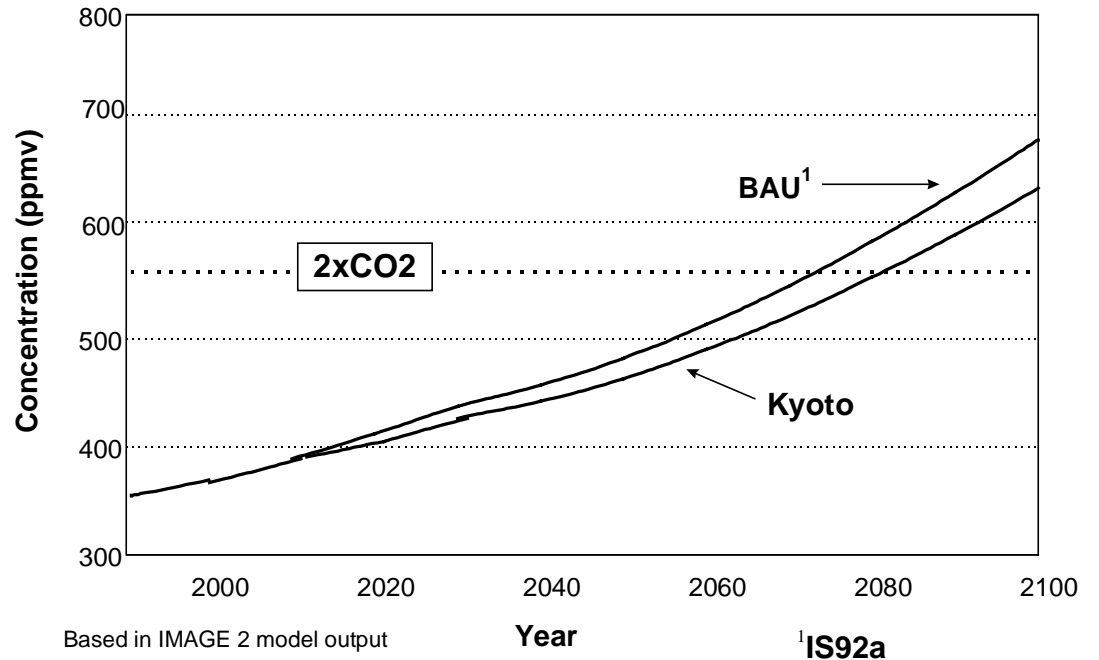


# Need for Effective Action Now

“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*

### GLOBAL CO<sub>2</sub> CONCENTRATIONS Kyoto Scenario vs BAU



**Mitigation:** Kyoto as an important first step. 50% reductions needed to stabilize atmospheric concentrations at 500 ppmv

**Adaptation:** necessary given the inevitability of 2xCO<sub>2</sub>



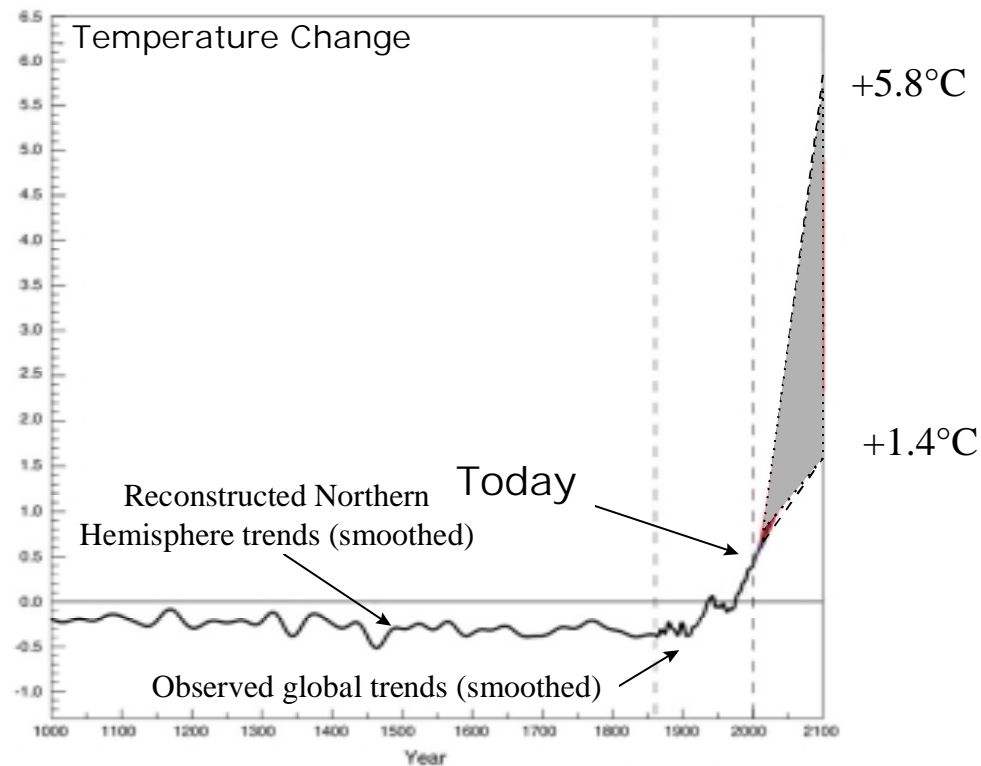
# Climate - Temperature Record

- 4-6°C for central and northern Canada
- 3-4°C along western and eastern coastlines
- 3-8°C in Ontario



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## Hemispheric Temperature Trends of the Past Millennium and Predicted Increase by 2100



Source: Mann *et al.* 1999; IPCC TAR 2001

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# Climate Change Impacts in Canada: Costs of Inaction

- Coastal Regions, especially in the Maritime Provinces
- Communities dependent upon agriculture in the Prairies
- Arctic regions and aboriginal communities
- Urban areas, especially health impacts

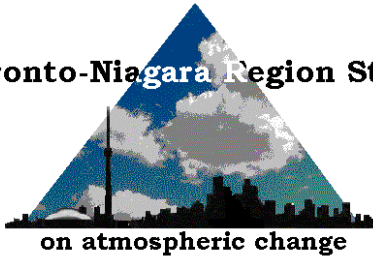
1.5% GDP, \$8-12 Billion (1988 dollars) annually; \$3.5-24.5 Billion



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## Toronto-Niagara Region Study



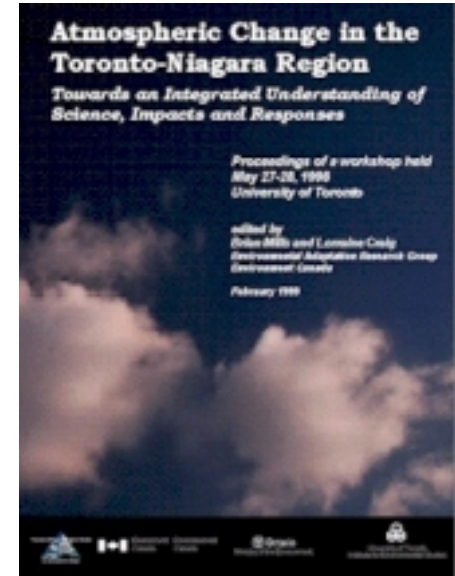
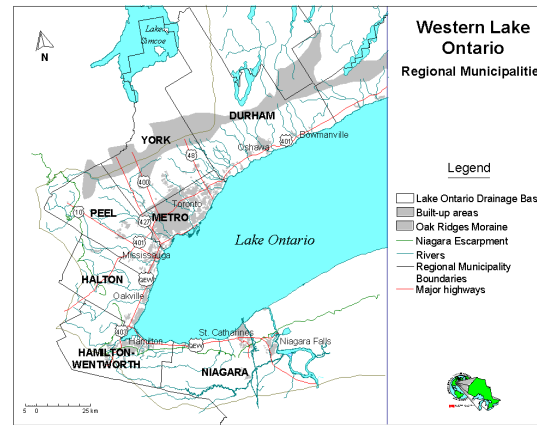
# Atmospheric Change in the Toronto-Niagara Region: Assessing the Impacts and Effectiveness of Mitigation and Adaptation Response Strategies

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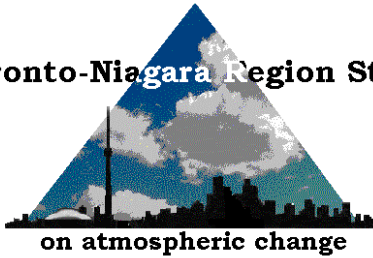
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Toronto-Niagara Region Study



## Atmospheric Change in the Toronto-Niagara Region: Assessing the Impacts and Effectiveness of Mitigation and Adaptation Response Strategies

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# Impacts and Adaptation Synthesis Report

- Water Resources
  - Quantity and quality
- Energy sector (electricity and natural gas) in terms of:
  - Generation
  - Transportation, transmission and distribution
  - Demand
- Human Health



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# Human Health Effects

- Morbidity, hospital admissions and death due to:
  - Temperature Extremes
  - Extreme Weather Events
  - Vector-borne and Rodent-borne Diseases
  - Air Quality and Indoor Environments
  - Water-borne and Food-borne Diseases
  - UV-Radiation



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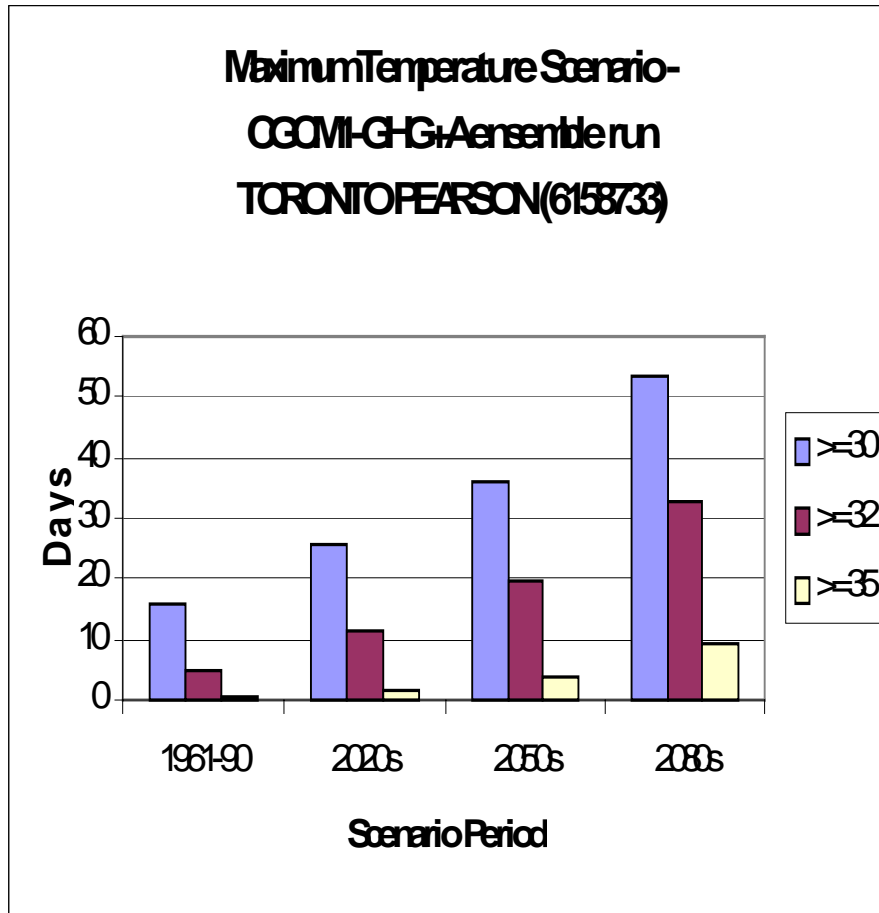
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# Climate Change Health Effects

- Morbidity, hospital admissions and mortality due to extreme weather events and water-borne diseases are difficult to predict, but are expected to increase
  - (1985) Barrie Tornado: 12 deaths, 155 injuries
  - (2000) Walkerton *E. Coli* O157 , 7 deaths, 2,300 illnesses
  - (1954) Hurricane Hazel, 81 deaths, 2,000 evacuated
- 1,000 reported cases of imported Malaria in Canada in 1997 (up to 2,000 unreported cases)
- 370 deaths in Ontario due to melanoma (2000)



# Climate Change and Heat Stress



	Days over 32°C	Days over 30°C
Baseline (1961-1990 average):	5	16

Current elderly mortality: 19 average, 150 extreme

Future scenarios:	CGCM1	CGCM1
2020s	11	26
2050s	20	36
2080s	32	54



# Climate Change and Heat Stress

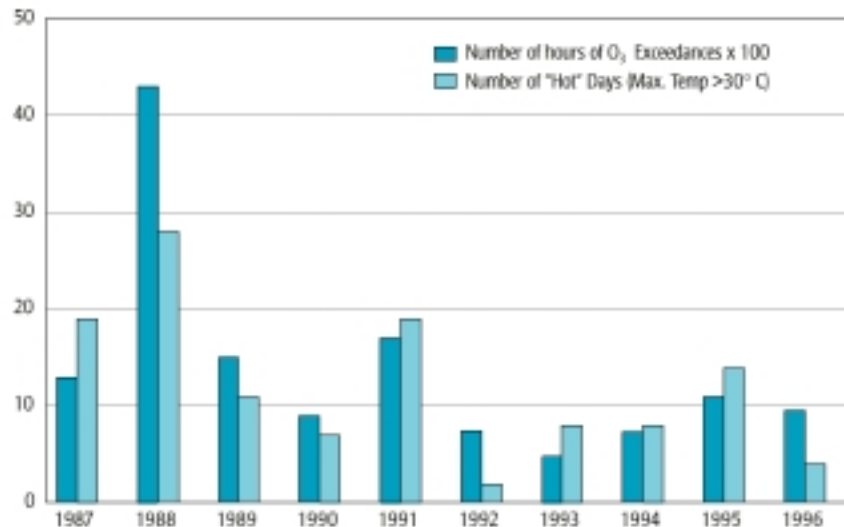
- 239-835 heat related deaths annually in Toronto alone by 2080s, based on current population of 2,481,494
- Projected heat-related deaths in the TNR during an **average** summer by mid 2020s
  - # days when *apparent temperature* exceeds the heat-stress threshold (11-26)
  - heat-related mortality among the elderly for Toronto (0.94/100,000) and Hamilton (1.32/100,000)
  - Projected elderly population: 1.53 - 1.71 million
  - **171 - 447 deaths**



# Climate Change, Air Quality and Human Health

## Influence of Hot Weather on O<sub>3</sub>

10-year trend for ozone exceedances and "Hot" days (1987-1996)

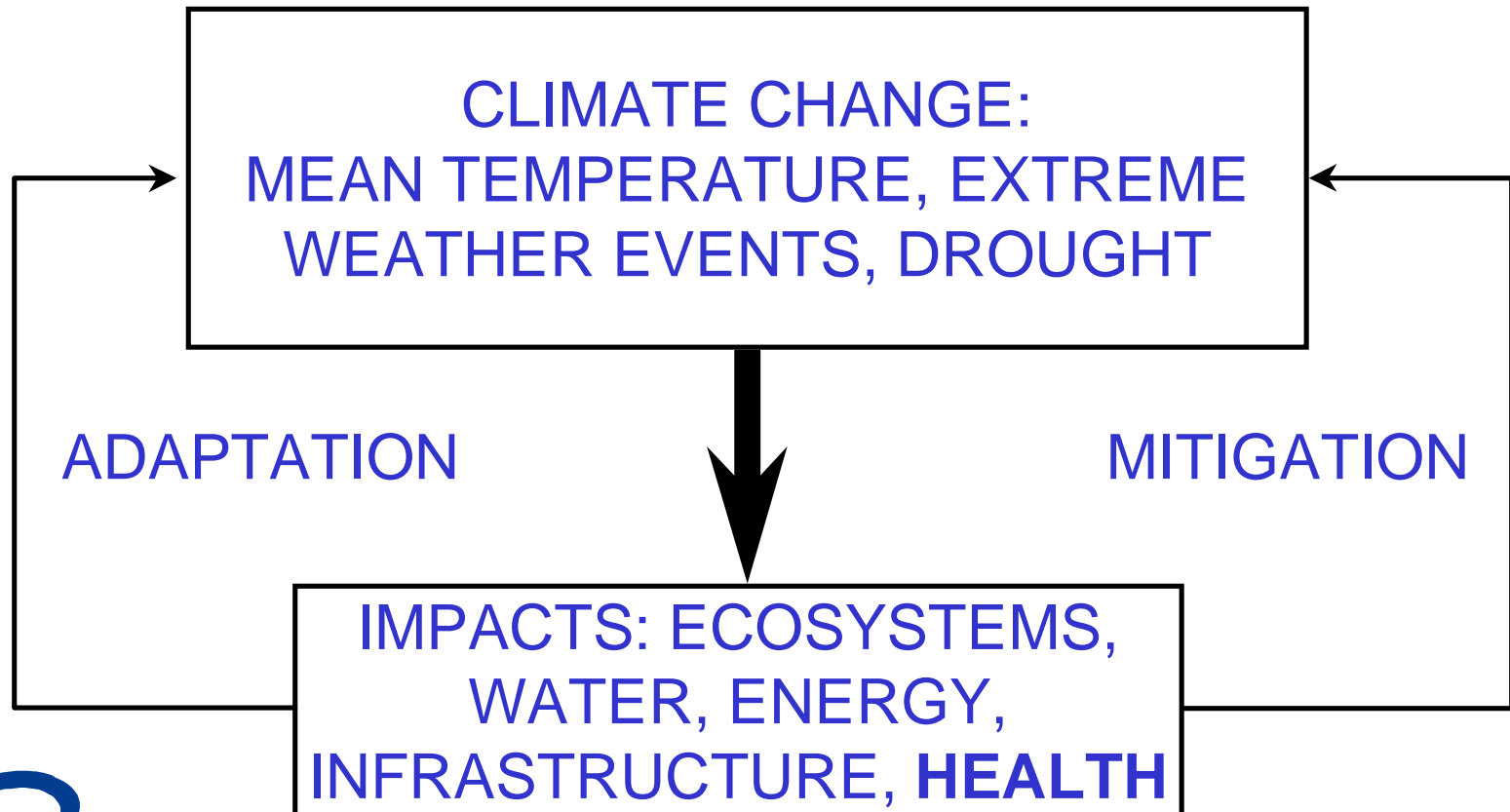


Note: For 22 ozone sites operated over 10 years

- 1,000 premature deaths in Toronto annually
- 2001 most smog alerts since 1993
- Offensive air masses could increase in frequency from 5% to 23% (29-39%)
- Background O<sub>3</sub> could increase by 40 ppb
  - currently 30-40 ppb



# Responding To Climate Change



# Adaptive Measures to Climate Change Health Effects

- **Public Education & Communication**
- **Surveillance & Monitoring**
- **Ecosystem Intervention**
- **Infrastructure Development**
- **Technological/Engineering**
- **Medical Intervention**
- **Heat Stress**
- **Extreme Weather Events**
- **Infectious Diseases**
  - **Water-borne**
- **Smog**
- **UV Radiation**



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EXTREME WEATHER EVENTS,  
INFECTIOUS DISEASES, UV RADIATION

## HOT TEMPERATURES AND SMOG

PE & C: INCREASED AWARENESS;  
INDIVIDUAL PRECAUTIONARY ACTIONS

S & M: WARNING SYSTEMS

EI: TREE PLANTING, VERTICAL AND  
ROOFTOP GARDENS; LAND USE  
PLANNING

ID: ACCESS TO AIR CONDITIONED  
FACILITIES; ACCESS TO MORE  
EFFICIENT AIR CONDITIONING

T/E: DESIGN AND RETROFIT OF  
BUILDINGS

PE & C: INCREASED AWARENESS;  
INDIVIDUAL PRECAUTIONARY ACTIONS;  
ACTIONS TO REDUCE EMISSIONS

S & M: WARNING SYSTEMS

EI: MORE GREEN SPACE; LAND USE  
PLANNING, REDUCED SPRAYING

ID: IMPROVED PUBLIC TRANSIT;  
HOUSEHOLD AND COMMUNITY ENERGY  
EFFICIENCY

T/E: INCREASE IN ALTERNATIVE AND  
GREEN FUELS IN VEHICLES AND ENERGY

ADAPTIVE & MITIGATIVE  
RESPONSES: HEALTH  
INFRASTRUCTURE



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# Key Knowledge Gaps

- SYNERGISTIC EFFECTS FROM HEAT AND SMOG
- EXPOSURE TO HEALTH RISKS BETWEEN OUTDOOR AND INDOOR ENVIRONMENTS
- VULNERABLE GROUPS: CHILDREN AND THE ELDERLY; OCCUPATIONAL HEALTH
- URBAN DIFFERENTIATION; URBAN VERSUS RURAL HEALTH RISKS
- INTERACTIONS BETWEEN MITIGATIVE AND ADAPTIVE ACTIONS



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# Co-benefits of Mitigative and Adaptive Responses

- **URBAN FORESTATION/NATURALIZATION**
  - **REDUCES URBAN HEAT ISLAND; REDUCED RISK OF HEAT STRESS; REDUCES USE OF AIR CONDITIONING AND LEADS TO IMPROVED AIR QUALITY**
  - **PROVIDES PROTECTION FROM UV-B**
  - **REDUCES GROUNDWATER FLOW AND FLOODING DURING EXCESSIVE RAINFALL EVENTS**
  - **ENCOURAGES OUTDOOR ACTIVITY AND PROMOTES GOOD PHYSICAL HEALTH**
  - **INCREASED HABITAT FOR VECTORS?**



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- **ACCESS TO AIR CONDITIONING**
    - **REDUCED RISK TO HEAT STRESS**
    - **REDUCED ENERGY USE, IMPROVED AIR QUALITY**
    - **HEALTHIER INDOOR ENVIRONMENTS**
  - **TRANSPORTATION: Group Commuting; Schedule Change; Active Commuting**
    - **IMPROVE AIR QUALITY**
    - **REDUCE URBAN HEAT ISLAND EFFECT**
    - **IMPROVE PHYSICAL AND MENTAL HEALTH**
    - **IMPROVE PRODUCTIVITY AND \$\$**
- S-M-A-R-T Movement (Save Money and the Air by Reducing Trips)**

