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Canadian Climate Change Scenarios Network (CCCSN.CA): Model Output for Climate Change Impacts and Adaptation Studies



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Adaptation and Impacts Research
Section (AIRS) Environment Canada**

**OCCIAR Workshop
Sudbury, Ontario**

27 October 2010

Simplified Steps of Any Climate Change Adaptation Study

- Define the where, when and by how much temperature, precipitation and other climate factors have changed in the past, and will change in the future
- Identify current vulnerabilities locally
- Assuming projections, how do the impacts and vulnerabilities then change?
- Given the risk associated
 - Do nothing (accept the risk)
 - Plan a solution (adaptation study)
 - Adapt (implement actions)



Even with Simplification of the Adaptation Process – Where are we with the public perception of Climate Change?

A very recent Yale University study indicates:

Not very far unfortunately...

<http://environment.yale.edu/climate/>



Americans' Knowledge of Climate Change



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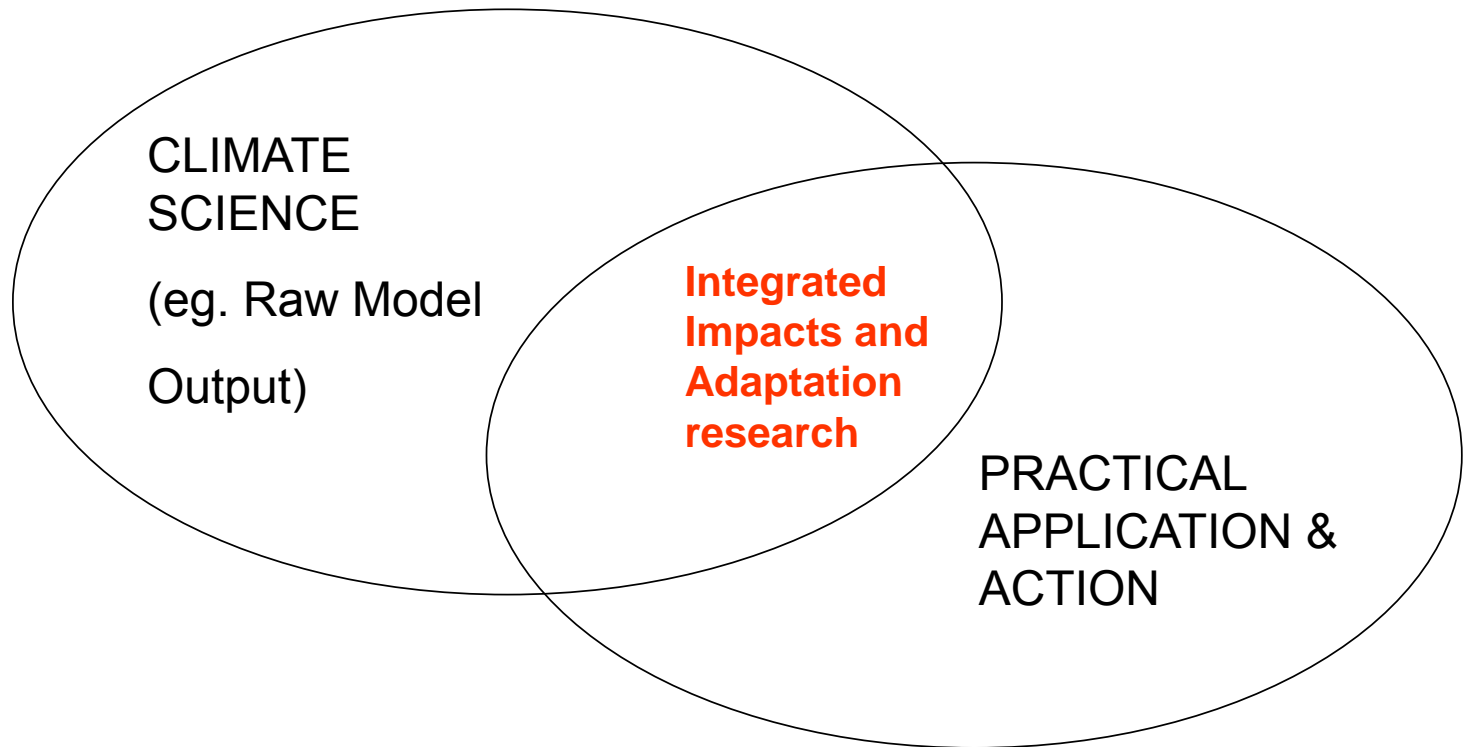
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Some Yale Study Findings...

- 63% believe that global warming is happening
 - 8% have knowledge equivalent to an A or B,
40% would receive a C or D,
52% would get an F.
 - Gaps in knowledge and common misconceptions lead some people to doubt that global warming is happening
 - Misunderstand the causes and therefore the solutions, and to be unaware of the risks.
- Thus many lack some of the knowledge needed for informed decision-making in a democratic society.



The Adaptation and Impacts Research Section (AIRS) of Environment Canada has a unique place...



ADAPTATION AND IMPACTS RESEARCH ENVIRONMENT CANADA

Future Climates

Climate Change
Model Outputs
(>50 possibilities)

Present Climate

Weather Forecasts
Seasonal Predictions

Analytical Science

- Expert Analysis
- Visualization
- Scenarios & Ensembles
- Downscaling
- Verification & Validation
- Re-analysis fields

Tool Development

- Impacts Data Bases
- Forensic & Expert Analysis
- Bio-climate Profiles
- Hazards → Risk Management
- Extreme Event Models
- Analysis for Legislation/Policy
- Vigilance & Early Alerts/Forecasts
- Guidelines & Best Practices

Past Climates

Climate Analysis
Paleo History

Related Data

Infrastructure
Biodiversity
Land-use Population

Impacts

Defining
the Problem
(Impact Studies)

Knowing
the Problem
(Multi-Sect oral
Expert Knowledge)

Disregarding
the Problem
(Priority Setting)

Adaptation Actions

Defining
the Solution
(Developing
Alternatives)

Knowing
the Solution
(Taking Action)

No Action

Climate Services

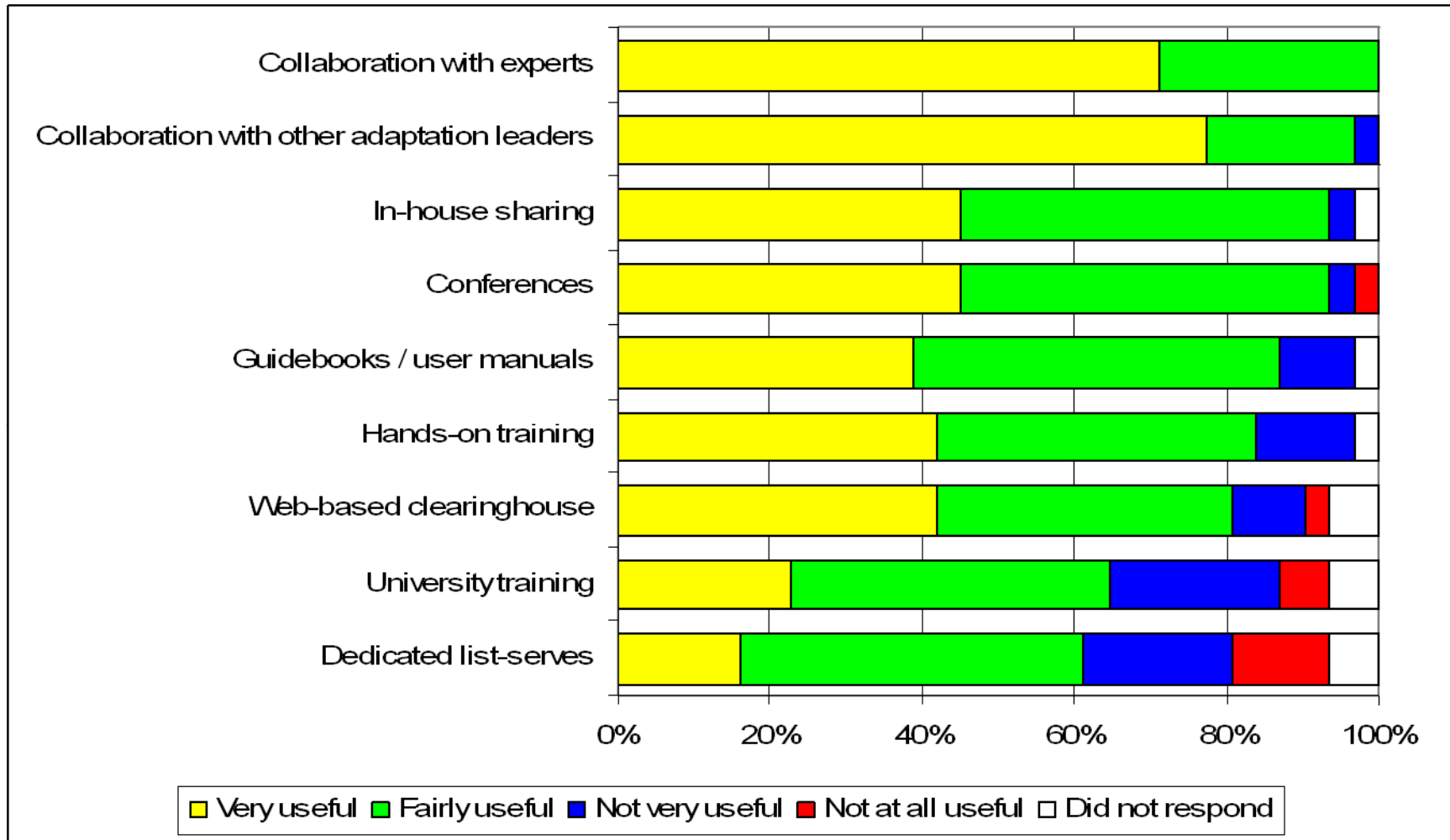
Learning Together
(Partnerships)

Sharing the
Knowledge

Monitoring
Changes

**A
C
T**

AIRS Study: Adaptation Needs



Environment Canada

- Is currently investigating the development of an integrated 'climate service'
- This is something that the US and many European met agencies have already implemented
- A one-stop shop for environmental info
- Will take some time to implement since still in the discussion phase
- Until then – sources are dispersed



Establishing the current climate:

- Length of record (30 years of data?)
- Continuous records
- Up to present?
- Is the station representative?
- How often have extreme events happened in the past?



Filling the gap for practitioners...

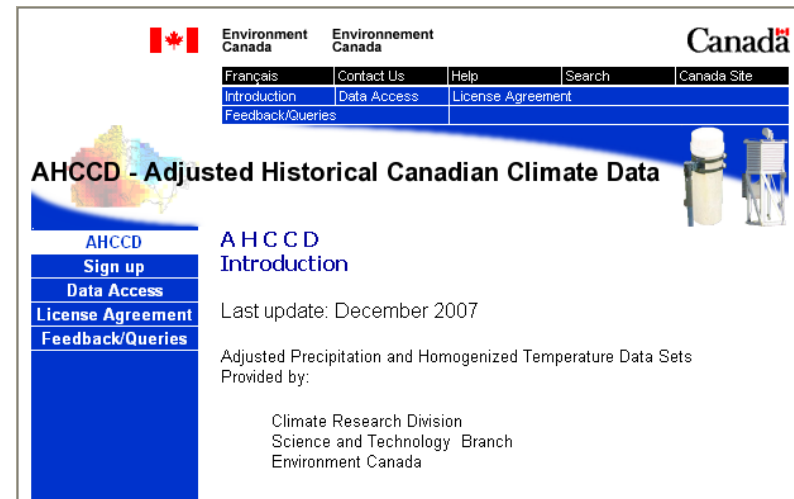
Observed historical climate data

(www.weatheroffice.com)



Observed long-term climate data
(Adjusted/Homogenized)

(www.cccma.bc.ec.gc.ca/hccd)



AHCCD - Adjusted Historical Canadian Climate Data

[AHCCD Sign up](#)
[Data Access](#)
[License Agreement](#)
[Feedback/Queries](#)

AHCCD Introduction

Last update: December 2007

Adjusted Precipitation and Homogenized Temperature Data Sets
Provided by:

Climate Research Division
Science and Technology Branch
Environment Canada



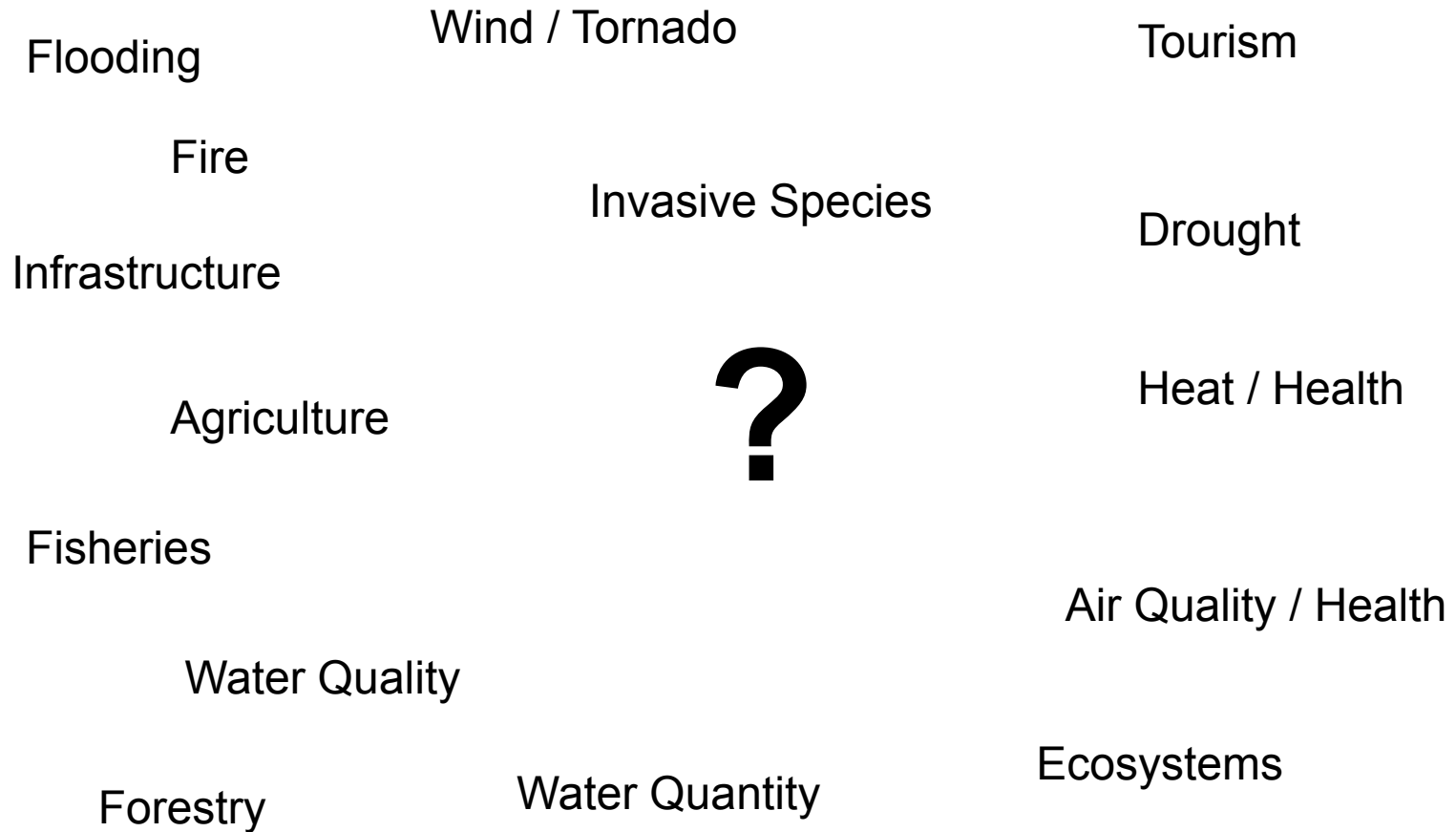
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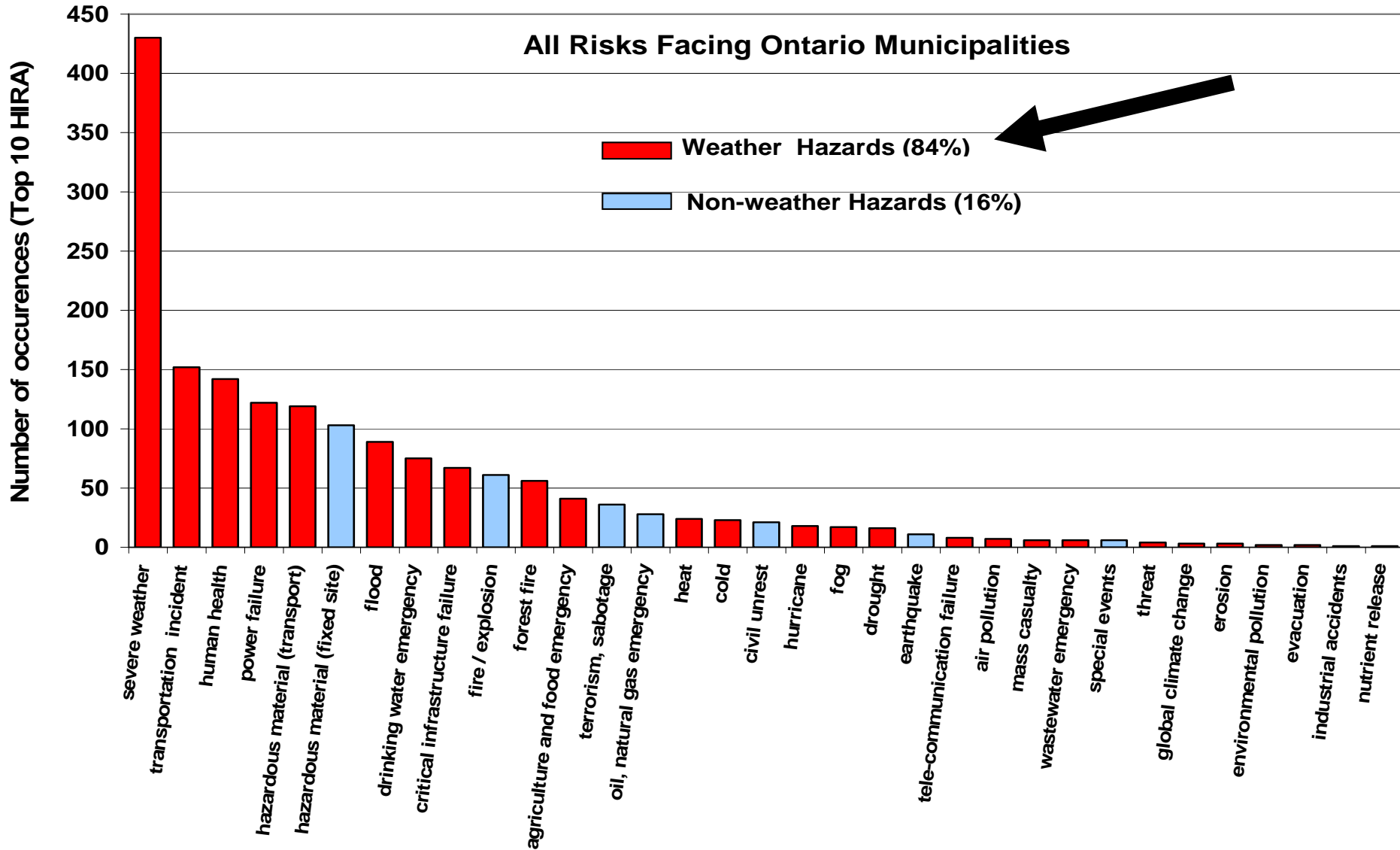
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Establishing vulnerabilities:

Varies considerably by location – so local knowledge is important



AIRS Study (Ontario Municipality Survey):



Filling the gap... AIRS product:

Atmospheric Hazards

www.hazards.ca

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Atmospheric Hazards - Canada

www.hazards.ca

Français Home Contact Us Help Search canada.gc.ca

Welcome to the Canadian Atmospheric Hazards Network

A portal to five regional Hazards sites across Canada:

Pacific and Yukon Prairie and Northern Ontario Quebec Atlantic

Every year, Canadians are impacted by severe weather events such as snowstorms, severe thunderstorms, wind storms, heat waves and tornadoes. Damage to or loss of homes, properties and businesses as well as disruption and damage to electrical, communication and transportation systems can result from these storms. Heat waves and cold spells can be hazardous to human health.

Quebec Region

Ontario Region

The numbers and costs of extreme weather events, particularly the more infrequent weather-related disasters, are on the rise globally and in Canada. The social and economic toll from the weather disasters can be staggering. During the 1st week of January, 1998, a crippling Ice Storm impacted about 25% of Canada's population in Ontario, Quebec, New Brunswick and Nova Scotia as well as 7 states in the Northeastern U.S. In 2010, it remains Canada's costliest weather disaster with total insured damages estimated at over \$5 billion and 28 human fatalities in Canada. Ontario's most expensive weather disaster occurred on August 19, 2005 when extreme rainfall resulted in destructive flash flooding in Toronto and 2 tornadoes struck northwest of the City. Damages exceeded \$500 million in insured losses, also marking this as the second most expensive insurance storm event in Canada's history.

- Historical weather-related event frequencies across Canada

- Heat, cold, flood, tornado, hurricane, human health, wind, etc.

- Specific event listings

COMING SOON:
hazard projections from GCMs

Filling the gap... AIRS product:

The Canadian Climate Change Scenarios Network (CCCSN.CA)

(www.cccsn.ca)

CCCSN - RCSCC
Canadian Climate Change Scenarios Network / Réseau Canadien des scénarios de changements climatiques

National Network / Réseau National

Select Your Location / Choisir votre Location

The CCCSN consists of separate nodes, representing different regions of Canada and with their own research specialty. Each node is hosted in partnership with our university collaborators and the Adaptation and Impacts Research Section (AIRS) of Environment Canada.

Le RCSCC comporte de nœuds distincts dont chacun représente une région du Canada. Chaque nœud est hébergé par un partenaire avec le concours de la Section de la recherche sur l'adaptation et les répercussions (SRAR) de l'environnement Canada.

[Important Notices / Avis Importants](#)
[Adaptation and Impacts Research Section / Section de la recherche sur l'adaptation et les répercussions](#)

Other nodes are coming soon / D'autres noeuds viendront bientôt

- University Partnership
- GCM and RCM data, tools
- Added-value 'Bioclimate profiles' on degree days, frost/freeze, water budget, temperature exceedances, etc.
- ENSEMBLE results – an average of ALL GCM models for temperature and precipitation so no decision on which models to use
- NEW design of site to better reflect regional research



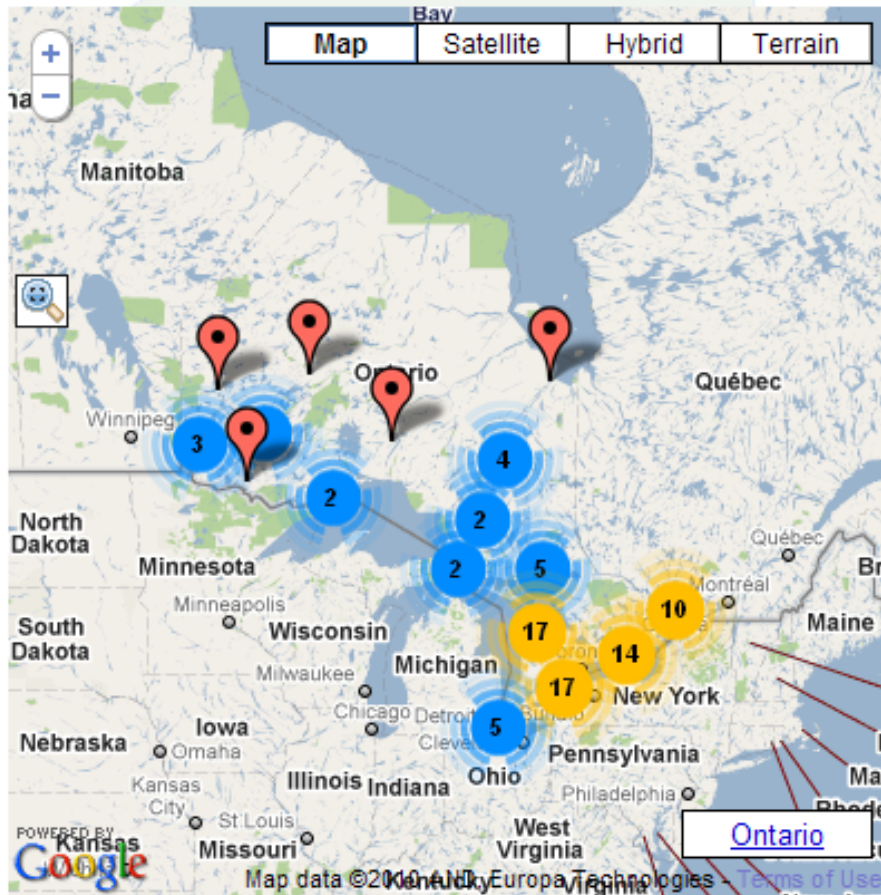
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AIRS publications for Ontario

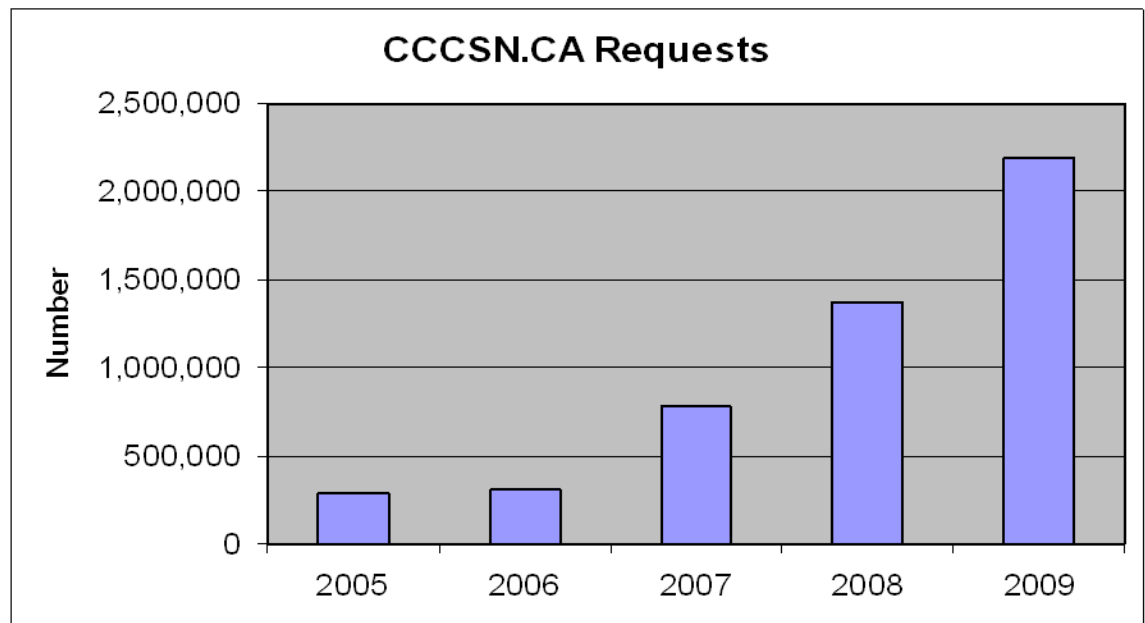
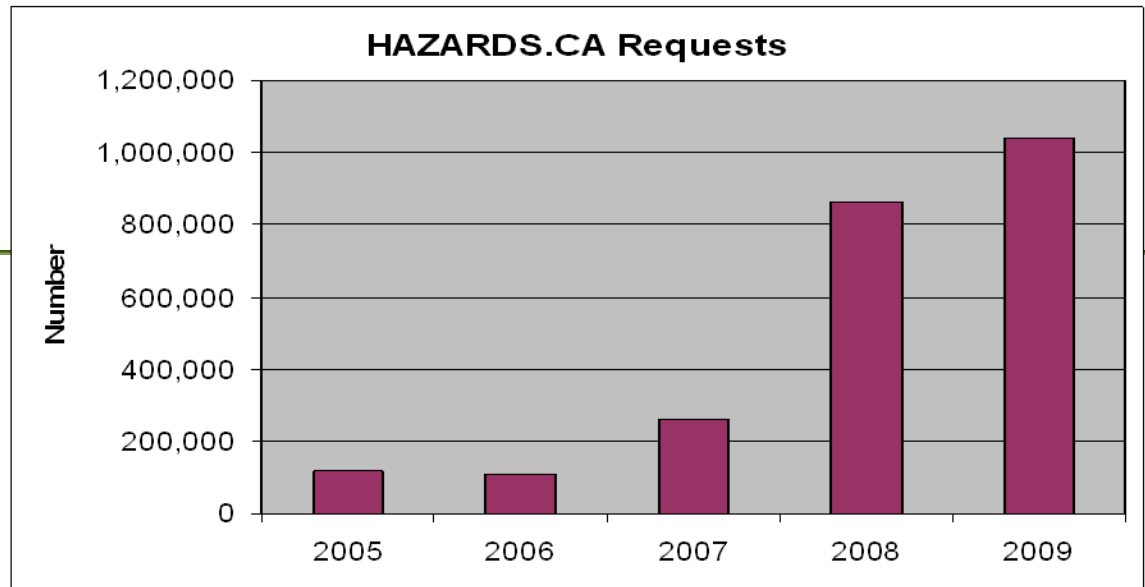
- o Ontario-specific publications, reports, presentations (or use map below to select)



<http://ontario.cccsn.ca/?page=regional-main>



Activity on the websites is growing



NEW – Making it local □ the ‘Localizer’

For a customized summary report on climate change projections for your location, simply enter your town name here



CCCSN - RCSCC

CCCSN - RCSCC

Canadian Climate Change Scenarios Network Réseau Canadien des scénarios de changements climatiques

Localizer
Localisateur

Please enter your postal code or town name here
Entrez votre code postale ou nom de ville ici

National Network
Réseau National

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Select Your Location

Choisir votre Location

[Important Notices](#) | [Avis Importants](#)
[Adaptation and Impacts Research Section](#)
[Section de la recherche sur l'adaptation et les répercussions](#)



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What the 'Localizer' offers:

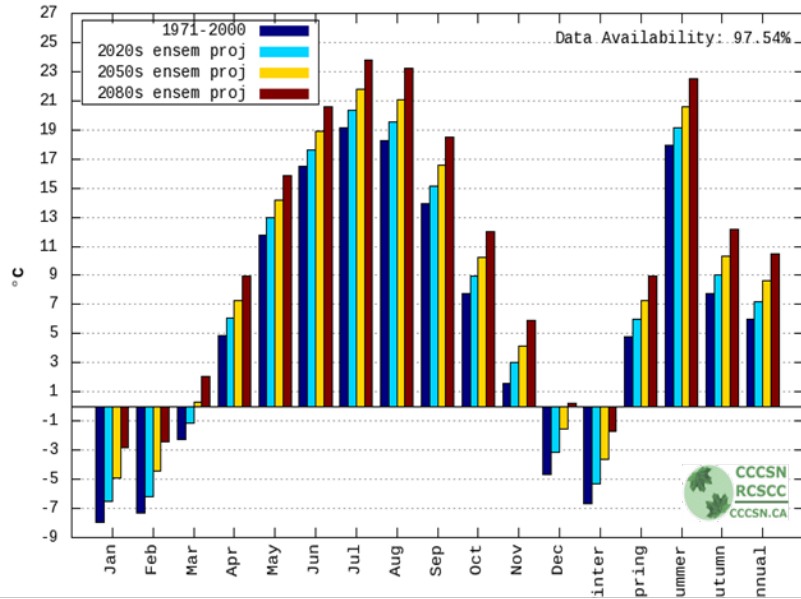
A quick and easy overview of projected local climate change

- No guesswork about which models of the 2 dozen available from the IPCC to select – the average of all is calculated
- For the standard 3 emission scenarios (A2-high, A1B-middle and B1-low)
- The standard deviation for each month is shown to give an idea of model uncertainty
- Monthly change in temperature and precipitation for the 2020s, 2050s and 2080s from the closest long-term EC observation station
- Tabular format with historical (1971-2000) observations as the baseline and projected change
- Uses GCM data – NOT Regional models

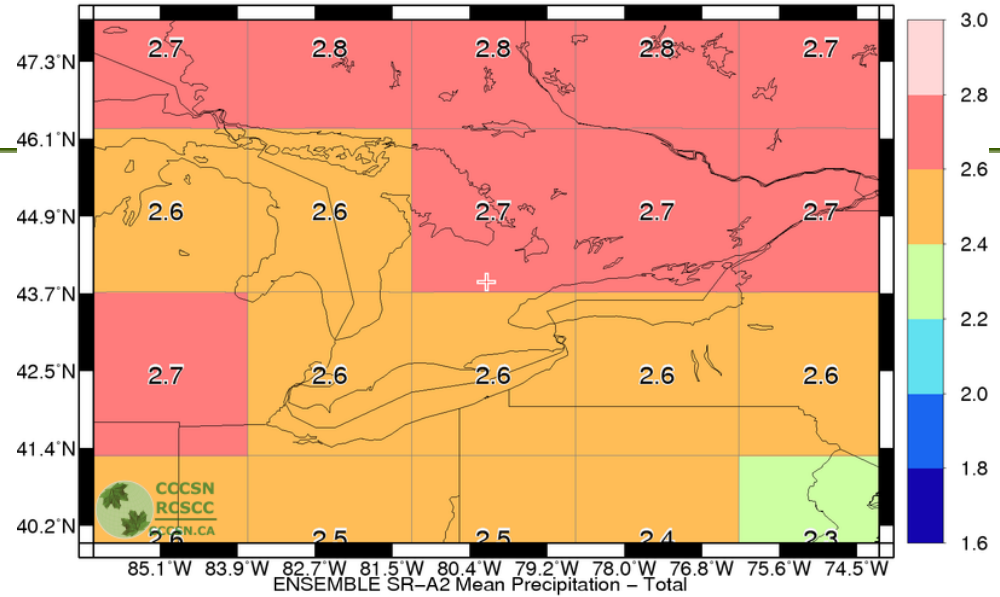


PARTIAL SAMPLE OUTPUT

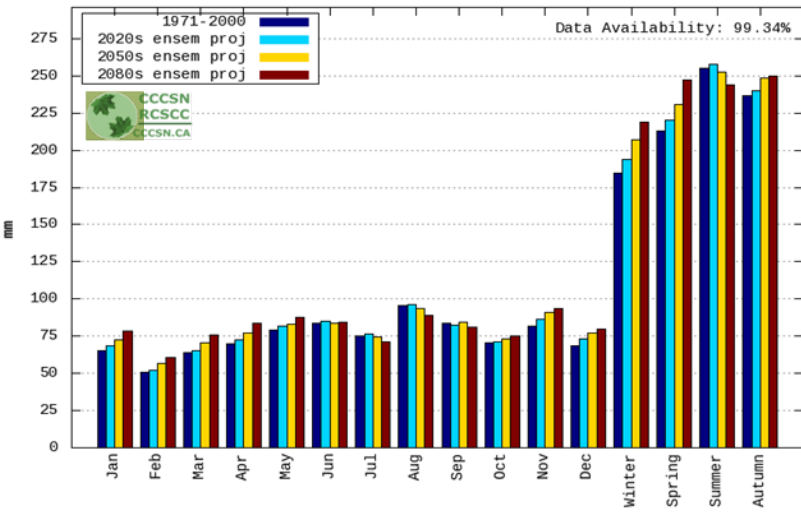
Air Temperature - Mean (2m)
6155790 Orangeville Moe - ENSEMBLE (SR-A2)



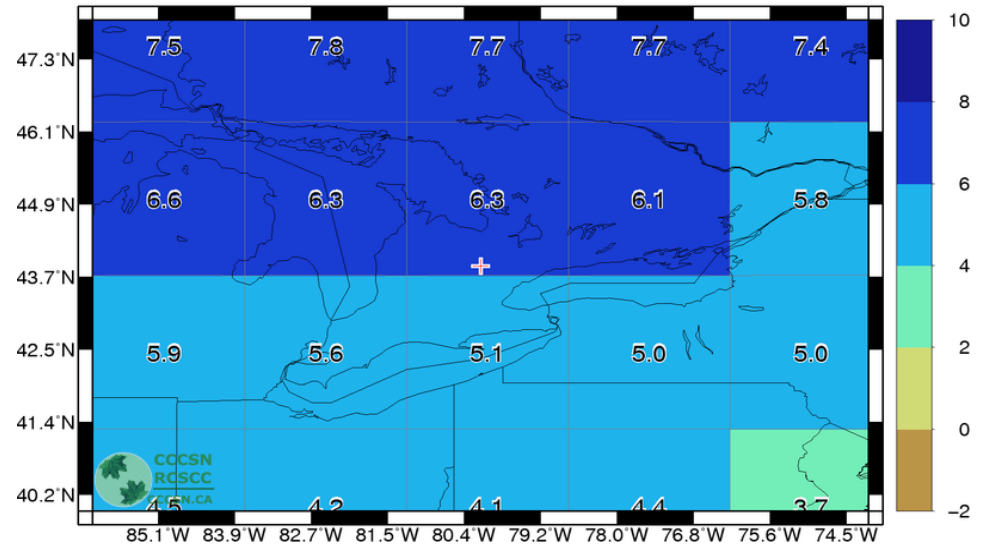
ENSEMBLE SR-A2 Mean Air Temperature - Mean (2m)
Annual anomaly 2041-2070 baseline 1971-2000 (°C difference)



Precipitation - Total
6155790 Orangeville Moe - ENSEMBLE (SR-A2)



ENSEMBLE SR-A2 Mean Precipitation - Total
Annual anomaly 2041-2070 baseline 1971-2000 (% difference)



Using 'BIOCLIMATE PROFILES' other details are available for the same locations as LOCALIZER

Temperature: Mean, Max and Min

Heating & Cooling Degree Days

Daily Corn Heat Units

Daily Growing Degree Days

Monthly Growing Degree Days

Daily Frost

Water Balance

Frequency of Precipitation

Maximum Temperature Above Threshold >25C, >30C, >35C

Maximum Temperature Below Threshold <0C, <-10C, <-20C

Freeze-Thaw Cycles

Accumulated Precipitation

Not available for ensemble model – you must select a model to apply



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CC projections: Can we answer everything?

- Some events we cannot determine from climate model projections and likely never will
 - too fine a spatial scale AND temporal scale

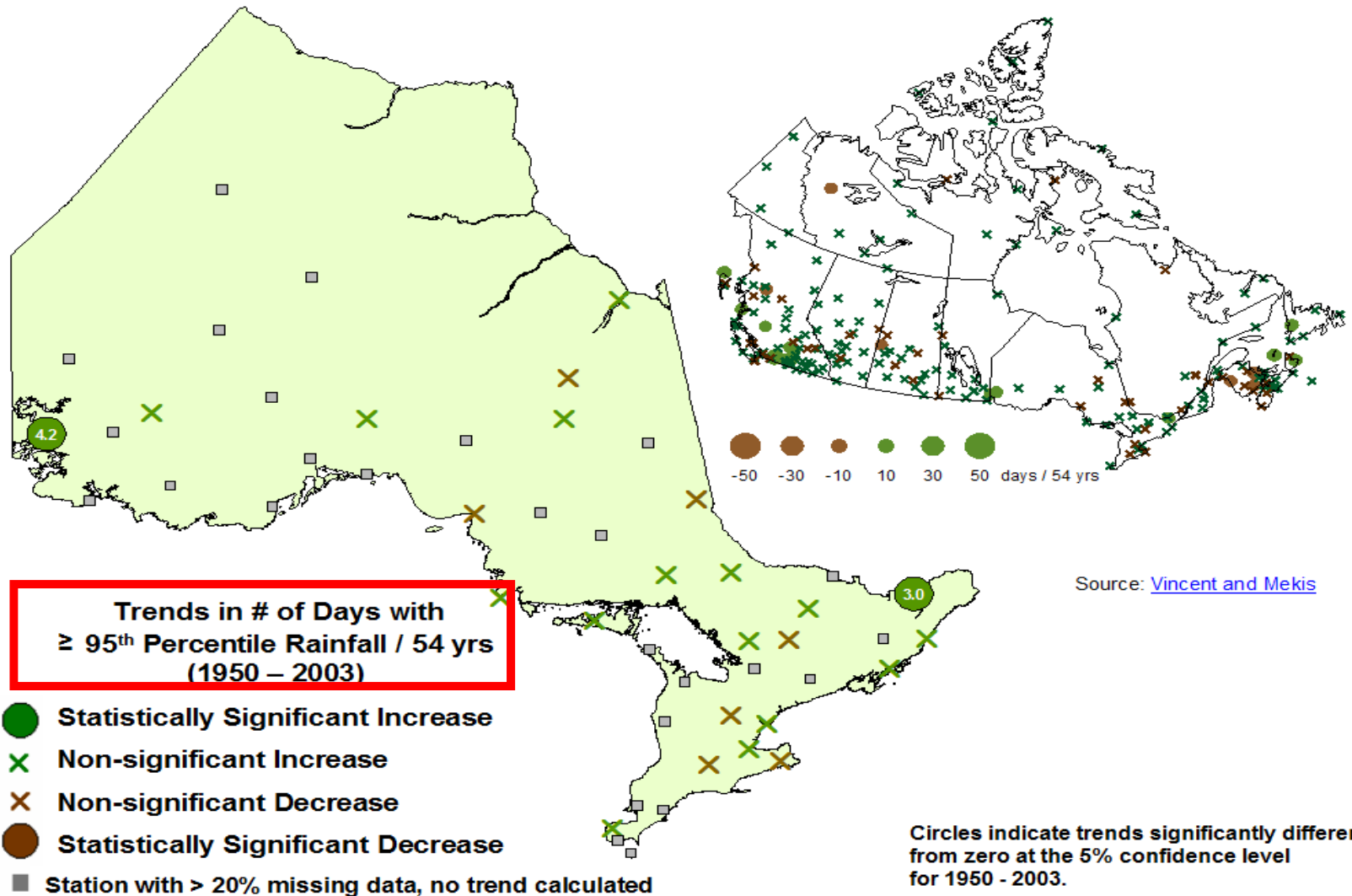
A good example: tornado occurrence

- Statistical downscaling can help with some extremes, but requires some operational expertise not available to all – Ontario Ministry of Environment is working on this issue.
- Sometimes all we have are historical trends...

This should not prevent us from making sound, 'no regrets' decisions!



Example: from hazards website



Source: [Vincent and Mekis](#)

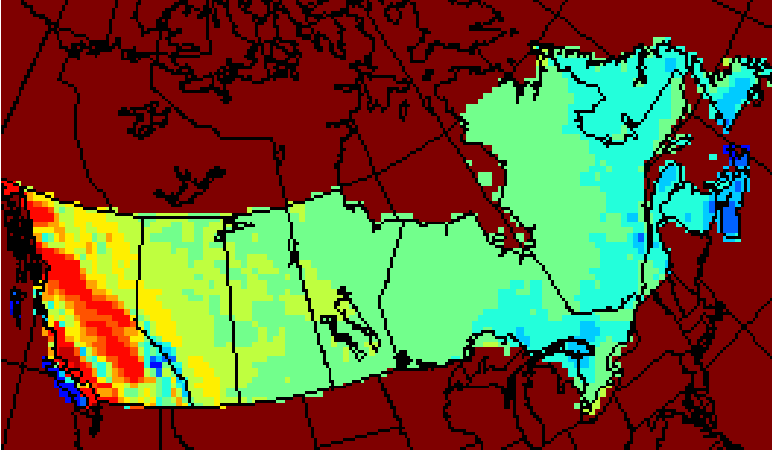


RCMs and Mean Precipitation:

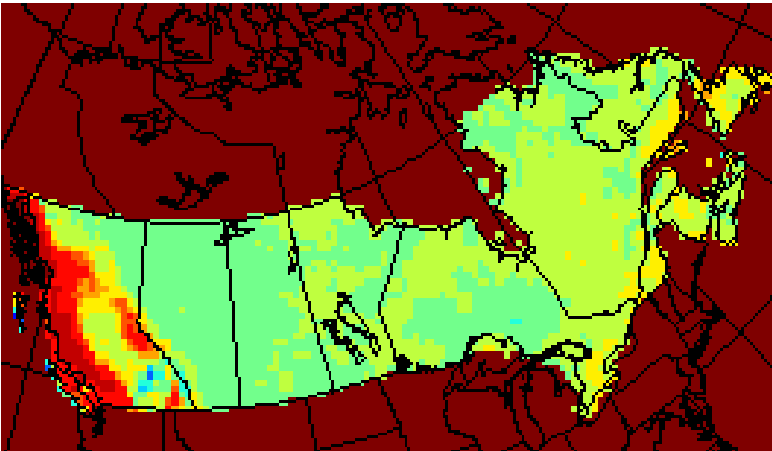
MEAN - Accumulated Daily Precipitation (PCP) in mm/day

30-yr Winter (Dec-Jan-Feb) Climatology (1971-2000)

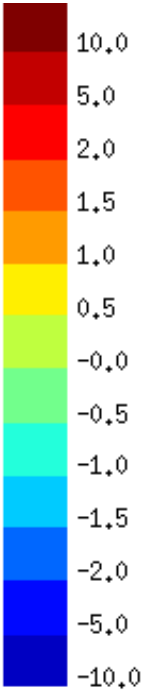
GRGM4.2.3
driven by
ERA-40



ARPEGE4.4
driven by
ERA-40



BIAS:



RCMs simulate more PCP on west coast (up to 2-5 mm/d), and less PCP along eastern and south-eastern Canada (except ARPEGE: up to 1 mm/d)

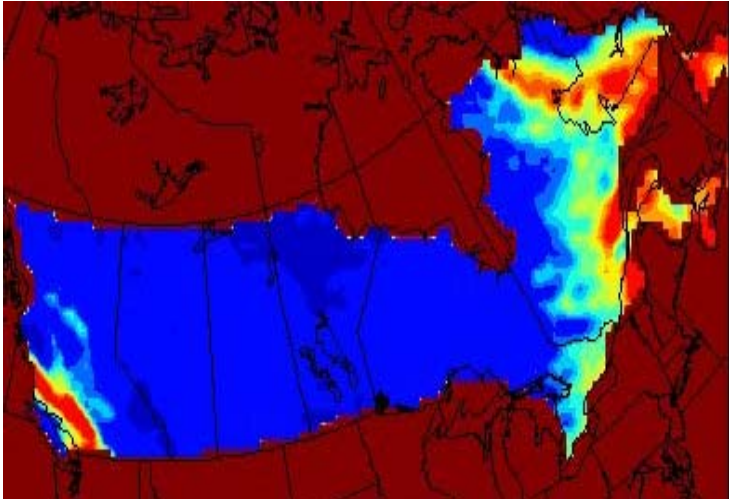
Dr. P. Gachon, EC.

RCMs and Extreme Precipitation:

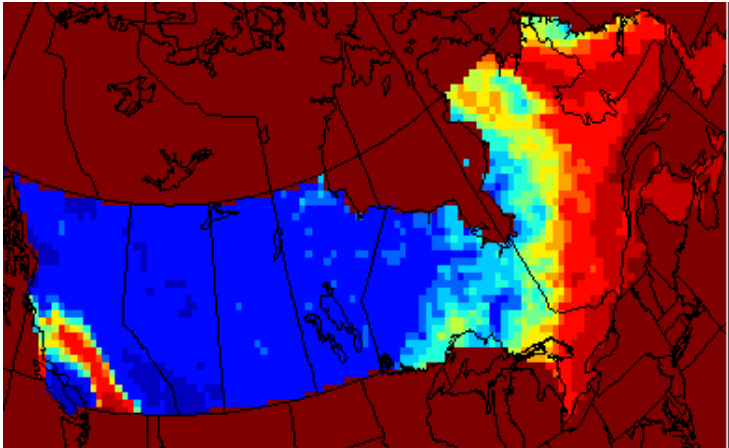
90th %tile of PCP, in mm/day

30-yr Winter (Dec-Jan-Feb) Climatology (1971-2000)

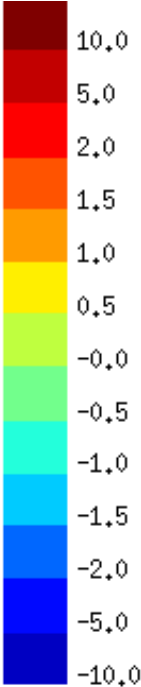
GRCM4.2.3
driven by
ERA-40



ARPEGE4.4
driven by
ERA-40



BIAS:



RCMs show **strong negative biases** (5-10 mm/d) across most of Canada except along eastern and south-eastern Canada (strong positive biases for ARPEGE)

Dr. P. Gachon, EC.



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How certain to we want/need to be?

The IPCC has specific text for certainty:

- Unequivocal
- Virtually certain (> 99%)
- Extremely likely (> 95%)
- Very likely (> 90%)
- Likely (> 66%)
- More likely than not (> 50%)
- Unlikely (< 33%)
- Very unlikely (< 10%)
- Extremely unlikely (< 5%)



It's a question of risk

- Hazards Identification Risk Assessment (HIRA) can help rank priorities for action
- No regrets actions can be taken when opportunities are available (replacement of infrastructure with 'upgrade' may be cost-efficient today)

Conversely,
Some events we could
never build for...



Jane-Finch.com

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Whats coming ...

- EC is working on updating the current building code statistics with the CSA
- Intensity-Duration-Frequency (IDF) statistics for extreme rainfall
- EC/U.S. EPA –A binational climate change adaptation strategy for Lake Superior
- Assemblage of a comprehensive impacts database relating impacts to meteorological observations
- Ongoing - Adaptation and Impacts Research Section has an extensive list of publications available

<http://cccsn.ca/?page=regional-main>



More...

- The next IPCC assessment (AR5) – with model data starting to come out next year
- EC will release a new updated version of its GCM – CGCM4/CanCM4
- New ‘Representative Concentration Pathways’ (RCPs) instead of the familiar A2, A1B, B1 will be used:
 - RCP3 GHGs reduced ‘substantially’
 - RCP4.5 GHGs stabilized before the year 2100
 - RCP6 GHGs stabilized after 2100
 - RCP8.5 GHGs continue to increase

More RCP info: <http://www.iiasa.ac.at/web-apps/tnt/RcpDb>

We add this new database to the CCCSN as it becomes available



Thank you...

- AIRS acknowledges the assistance of our university partners, other government agencies and the private sector in facilitating research across Canada
- Contact:

AIRS_INFO@ec.gc.ca



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