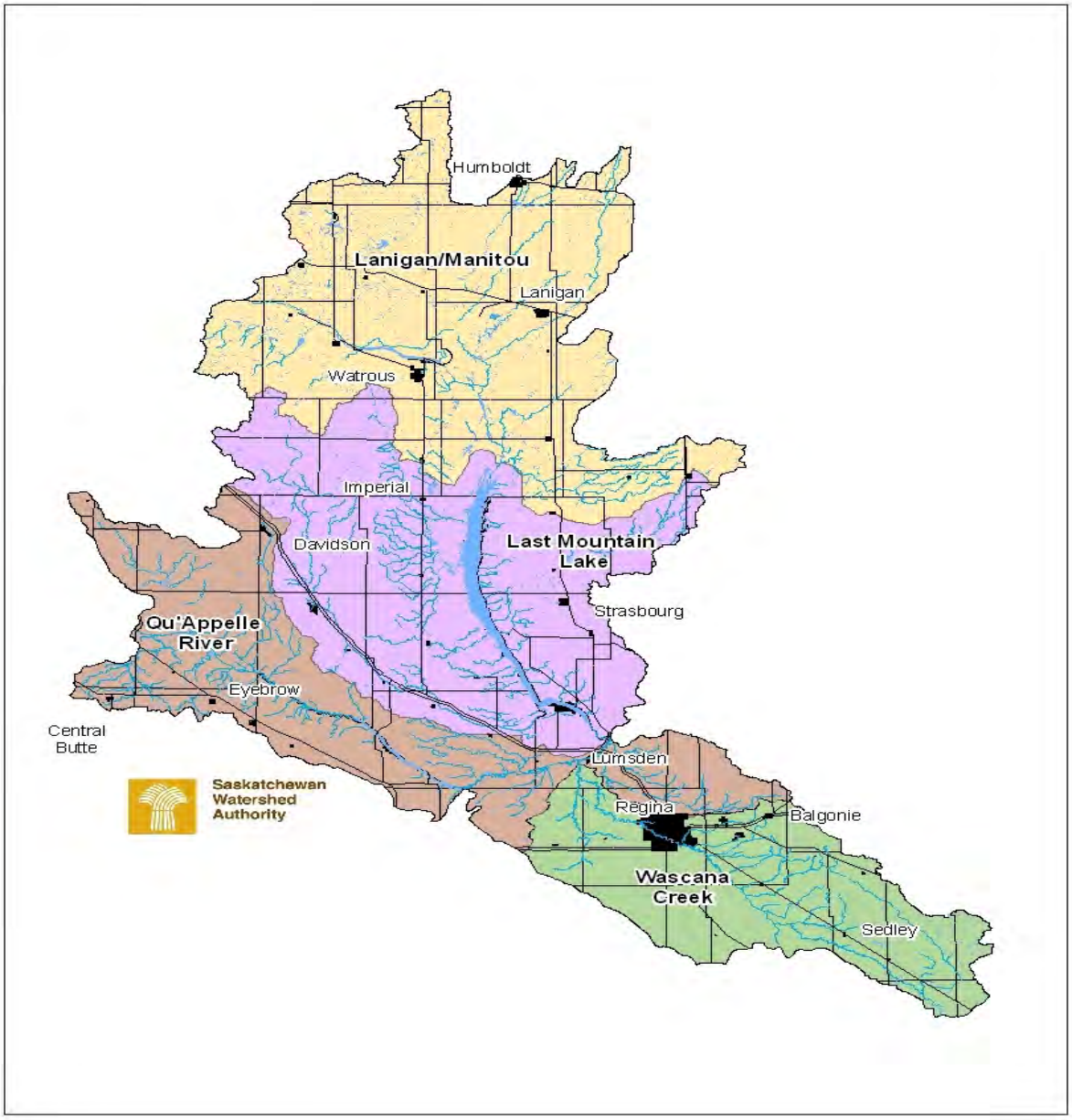

March 2012

WUQWATR Climate Extremes Preparedness Workshop

Final Report

WUQWATR
Wascana Upper Qu'Appelle Watersheds Association Taking Responsibility

Saskatchewan Watershed Authority

ACKNOWLEDGEMENTS

Report compiled by *Duane Haave, Wascana Upper Qu'Appelle Watershed Association Taking Responsibility.*

Workshop planning by *Wascana Upper Qu'Appelle Watershed Association Taking Responsibility, Saskatchewan Watershed Authority, and Natural Resources Canada.*

With Federal funding support through Natural Resource Canada's Regional Adaptation Collaborative Program

Natural Resources Canada Ressources naturelles Canada

Canada

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INTRODUCTION

Saskatchewan experiences some of the widest swings in temperature and precipitation in Canada The difficulties arising from extreme climate events in Saskatchewan in 2010 and 2011 are all the more remarkable given the natural extremities that people have adapted to over the last century.

The spring, summer and fall of 2010 were extremely wet in the Wascana and Qu'Appelle watersheds. These conditions persisted into 2011, with record snowpack, followed by heavy and persistent rainfall. Widespread flooding took place throughout Saskatchewan, with serious impacts on municipal infrastructure, particularly rural roads. Several extreme rainfall and storm events took place in both years, causing significant property damage to homeowners and businesses. Hardest hit were agricultural producers, who were unable to seed crops, manage weeds, and had great difficulty harvesting their crops due to extreme precipitation late in the fall.

Municipalities had great difficulty maintaining the crucial road network, and extensive mitigation measures were necessary, including pumping, sandbagging and the building of berms. Critical water and waste water infrastructure was threatened by flooding. Bridges and culverts were damaged or destroyed and needed to be replaced.

It became clear late in 2010 that municipal governments, especially Rural Municipalities, Towns and Villages, were struggling to cope with climate impacts. WUQWATR's watershed areas contain 122 municipalities, and only 9 of these have population greater than 1,000. Smaller municipalities were hampered by a lack of human resources, planning and financial capacity to deal with climate events outside of the ordinary. While municipalities have formal Emergency Measures plans, similar plans for dealing with the impacts of climate events and extreme weather are often incomplete or non-existent. Almost all WUQWATR municipalities filed claims with the Provincial Disaster Assistance Program in both 2010 and 2011. Many local communities engaged the services of the provincial Emergency Flood Damage Reduction Program, which provided emergency consultations with engineering staff and other specialists. While total numbers have not been compiled, it is safe to estimate from reports by municipal administrators that municipal claims for the PDAP program totaled tens of millions of dollars. Even with the assistance from senior levels of government, deductible amounts will place a heavy financial burden on smaller governments, and limit their financial capacity for years to come.

WORKSHOP PLANNING

It was clear that our member municipalities, and affiliated organizations, required a model for drought and flood preparedness which would be effective, simple and practical.
The Climate Extremes Preparedness workshop project was initiated in fall of 2010 by Jeremy Pittman, Climate Change Adaptation Specialist with the Saskatchewan Watershed Authority.
Initial meetings involved Mr. Pittman, Councilor Fred Clipsham, Chair of the WUQWATR Board and General Manager, Duane Haave. It was decided that given the ongoing climatic events underway, it would be best to schedule an event for late in 2011 or early in 2012. It was also decided that a practical workshop, rather than a higher level discussion, was more useful. Priority would be given to participants from municipalities and agencies within the watershed, but provision would be made for representatives from other watersheds and provincial agencies, if space allowed.
Several initial meetings led to the drafting of a Memorandum of Understanding and funding agreement.

Discussions around the MOU were followed by a telephone conference call between Pittman and Haave on March 9, 2011 with Pam Kertland of Natural Resources Canada, to discuss content and potential resource persons for the workshop.

The meeting agreed that it was most important to provide education on how to handle climate change, with a focus on practical approaches and inter-municipal co-operation. Given the continuing difficulties of dealing retroactively with climate events, the workshop needed to foster a pro-active approach of risk management rather than crisis management.

Ms. Kertland provided useful background about similar planning projects across Canada, and provided names and contacts for practitioners that could serve as resource people.

Discussion also centered on involving local experience in planning. Portage La Prairie, Manitoba and Swift Current, Saskatchewan were listed as possible resources.

High priority was assigned to having a credible presentation on the basic science of climate change, and a presentation on the potential local trends and future impacts.

In May of 2011, the WUQWATR Board had a lengthy discussion about the agenda and invitation list for the workshop, and the board struck a sub-committee to assist staff in organizing the event. Rod Halyk, retired municipal engineer for the City of Humboldt was appointed chair.

The Board committee determined that the Prairie Adaptation Research Collaborative (PARC) from the University of Regina should be engaged to start the workshop with a background presentation on

climate change and potential impacts. An invitation was extended to Dr. David Sauchyn of PARC, and was accepted. The General Manager was instructed to do background research on potential presenters to conduct a practical planning exercise. It was also decided that if time allowed, presentations of a local planning example should be scheduled, as well as possibly a presentation on the Saskatchewan Land and Infrastructure Resiliency Assessment project being conducted in Saskatchewan.

It was further decided that given continuing flooding issues, the workshop should be scheduled for December 2011, or January/February of 2012 at a date that would not conflict with the provincial meetings of the Saskatchewan Urban Municipalities Association (SUMA) and the Saskatchewan Association of Rural Municipalities (SARM), and avoid dates of local municipal council meetings. The workshop would be limited to one day, to encourage participation, and would need to adjourn by 3:30 to allow for travel time for out of town participants.

At subsequent sub-committee meetings, it was decided to hold the workshop in Regina, in the second week of February. WUQWATR staff solicited costs from 3 Regina hotels, and booked the Travelodge for February 8th, 2012.

General Manager Duane Haave researched background materials on various potential workshop resource people, and made the recommendation to the organizing Committee that WUQWATR engage Robert Black of Black Shield Preparedness Services. This recommendation was based on Mr. Black's previous work in developing preparedness planning in Arctic Canada, BC and Alberta.

Contact was made with Mr. Black, and an agreement that he would serve as facilitator for the workshop, as well as prepare a generic guide and workbook. He agreed to work with Dr. Dave Sauchyn of PARC to integrate their two presentations. After discussion on time requirements of the two main presenters, it was decided that time was not available for additional presentations, if the workshop was to meet its objectives.

PROMOTION

The announcement of the workshop took place at the WUQWATR Annual Meeting held March 28th, 2011 in Bethune. The event was also promoted at the 2011 Saskatchewan Association of Watersheds Conference in Humboldt in April 2011, through meetings of our four local Watershed Advisory Committees, and through newsletters. Flyers were developed for distribution at the SUMA conference tradeshow in January 2012, and at the Regina Regional Association of Rural Municipalities.

Workshop registration materials were mailed to all 122 WUQWATR Municipalities and by email to 125 local Watershed Advisory Committee members.

Registration materials were also emailed to a larger contact list including: SUMA,SARM, the Agricultural Producers Association of Saskatchewan(APAS), the Saskatchewan Association of Watersheds (SAW), the Provincial Council of Agricultural Diversification and Development Boards (PCAB), the provincial Ministries of Corrections and Public Safety, Environment, Agriculture, and Municipal Affairs and other provincial organizations.

HOSTING

Workshop Registration totalled 45 participants and 4 staff. Municipalities containing over 90% of WUQWATR's watershed population were represented. A significant percentage of WUQWATR's Rural Municipalities were in attendance. Fewer municipalities located more than one hour's drive from Regina were represented, as were fewer villages and small towns.

The workshop was launched with a comprehensive presentation by Dr. David Sauchyn of the Prairie Adaptation Research Collaborative at the University of Regina (Appendix D) Dr. Sauchyn is the foremost authority on climate change impacts in Saskatchewan, and participants were very engaged by his presentation, with many questions on the science behind his research and on potential impacts. The discussion continued for 45 minutes longer than the allotted time until all questions we answered.

The feature presentation on planning was led by Robert Black (Appendix E), who started with a description of his planning process. This was followed by a practical example of the planning process, utilizing real world examples provided by the participants. The group was very engaged in this process, and it was very successful in demonstrating the actual conduct of the planning process.

Participants were provided with Guides and Workbooks prepared by Mr. Black. (Appendix F)

OUTCOMES

Workshop organizers distributed an evaluation sheet. WUQWATR staff and Board members in attendance also solicited feedback from participants, and several emails and phone calls were received after the event.

Participant feedback from the workshop was very favourable (Appendix B). The presentation by Dr. Sauchyn was very well received. In written and verbal feedback, participants appreciated the practical nature of the planning exercise provided by Robert Black, and felt that it was a viable process for even the smallest municipality. There was very strong consensus that time and money spent on preparation would dramatically reduce the financial and social impacts of extreme events in the future. Participants with Emergency Measures background expressed their appreciation for the consistency of approach with Emergency Measures Organization (EMO) planning processes.

Strong support was shown for expanding planning and preparedness to achieve benefits from co-ordination at the regional or watershed level. However, there were concerns about the ability of communities to engage in regional planning before they had gone through the process of preparedness at the local level.

The Workshop Planning Committee believes that the project would have had greater impact if an additional workshop had been held in the northern part of the WUQWATR area, to maximize participation from that region.

The chief concern expressed was that the sense of urgency around preparedness would likely diminish as time passed. The Workshop Planning Committee strongly recommends that Provincial and Federal agencies support the creation of a Saskatchewan specific preparedness process as has been completed in other jurisdictions and that a series of workshops would be useful to allow for greater participation in climate preparedness.

APPENDIX A: WORKSHOP AGENDA

Agenda – Climate Extremes Planning Workshop

"Planning for Flood and Drought"

February 8, 2012 – Travelodge Hotel 4177 Albert St. Regina

Burlington-Berkeley Room (Lower Level)

8:30 - 9:00Registration

9:00 - 9:15 Introduction

9:15 - 10:15 Climate Scenarios and Impacts for Saskatchewan (Prairie Adaptation Research Collaborative – University Of Regina)

10:15 - 10:30 Break

10:30 - 12:00 Climate change preparedness planning (Bob Black, Black Shield Preparedness Services)

12:00 - 1:00 Lunch (Provided)

1:00 - 3:00 Climate Change preparedness planning exercise (Bob Black)

3:00 - 3:30 Participant feedback and wrap up

3:30 Adjourn

APPENDIX B: WORKSHOP PARTICIPANT EVALUATION

Evaluation Summary – WUQWATR Climate Extremes Planning Workshop Feb 8, 2011

Number of responses 27

Overall Rating

Poor	average	above average	excellent	no rating (blank)
0	1	13	7	6

Session 1 Climate Scenarios rankings 1 poor 2 average 3 good 4 very good 5 excellent

Average rankings

AV **3.85**

Handouts nil

Scope of content **4.2**

Depth of content **4.3**

Applicability of content **4.1**

Speaker – performance **4.6**

Speaker – knowledge **4.85**

Session 2 Preparedness planning ranking 1 poor 2 average 3 good 4 very good 5 excellent

Average ranking

AV 3.9

Handouts **4.4**

Scope of content **4.3**

Depth of content **4.1**

Applicability of content **4.3**

Speaker – performance **4.8**

Speaker – knowledge **4.7**

Participant Comments

- For municipalities to do even this as a basis will get emergency planning and risk assessment to the forefront.
- A better understanding of the causes and effects
- Very informative
- Very informative with regards to Climate change
- We have a good EMO plan but this gave me more to think about for this plan
- More specific topic for " plan for drought and flood: would be more beneficial
- Interesting, but it will take a lot of work to convince a small municipality of its importance
- The morning sessions, particularly session 1, were very useful to me , the afternoon session was a bit repetitive and tended to emphasize the obvious
- Valuable as it provided resource materials useful for a risk assessment process
- Sessions were very helpful taking into consideration the shifts in weather we have been experiencing lately.
- Very good
- More break time, break time is not wasted time.
- Good, gives us an idea how to do planning
- I will be able to go back and implement it in the City of Regina
- Both presentations were enlightening
- Too much time spent on going through the models in planning session, Probably better to go through a scenario and impacts from start to finish versus multiples.
- Very practical and adaptable to many types of risk scenarios.
- Learned a lot from Dave!
- Awesome workshop.

APPENDIX C: WORKSHOP REGISTRATION LIST

Name	Title	Representing
Wally Hurlburt	Emergency Planning	Consultant University of Regina
Joseph Alejandria	Senior Engineer	City of Regina
Wayne Chung	Project Engineer	City of Regina
Krystal Brewer	Town Administrator	Town of Lumsden
Dan Kirby	Councillor	Town of Lumsden
Jayne Leibel	Councillor	Town of Lumsden
Rod Halyk	WUQWATR Board	City of Humboldt
Kristina Nelson	PhD Candidate	University of Regina
Carl Friske	EMO and Fire Services	Ministry of Corrections and Public Safety
Rose Buscholl	Councillor	Rural Municipality of Colonsay #342
Larry Parrott	Reeve	Rural Municipality of El Capo #154
Roni Goulet	Mayor	Village of Buena Vista
John Smith	Councillor	Rural Municipality of Longlaketon #219
Don Barnett	Public Works Manager	Rural Municipality of Lumsden #189
Thomas McCord	EMO Coordinator	Town of Lumsden
David Esepeth	Watershed Planning	Saskatchewan Watershed Authority
David Sloan	WUQWATR Board	Wascana Conservation and Development #2
Ernie Oblander	WUQWATR Board, Reeve	Rural Municipality of Mount Hope #279
Owen Pekrul		Rural Municipality of El Capo #154
Sharie Hall	Administrator	Resort Village of Saskatchewan Beach
Jim Sigmeth		Rural Municipality of Edenwold #158
Enisa Zanacic		Saskatchewan Ministry of Environment
Jasmine Wang		Saskatchewan Ministry of Environment
Ian Alarcon		City of Regina
Gary Howland		Lumsden, Saskatchewan
Dwayne Radmacher		Rural Municipality of Edenwold #158

Name	Title	Representing
Shelley Kilbride	Policy Manager	Saskatchewan Association of Rural Municipalities
Claudette Halladay	WUQWATR	Rural Municipality of Marquis
Colleen Fennig	Technician	WUQWATR
Merlin McFarlane	Exec. Director	Saskatchewan Conservation and Development Assoc.
Gary Nieminen	Consulting Engineer	Regina, Saskatchewan
Tim Davies	WUQWATR Board	Resort Village of Manitou Beach
Milo Grimsrud		Saskatchewan Ministry of Agriculture
Arlynn Kurtz		Agricultural Producers of Saskatchewan
Candace Frederickson		Provincial Council of ADD Boards
Jim Supynuk	WUQWATR Board	Resort Village of North Grove
David Pattison		Long Creek AEGP
Darol Owens		Rural Municipality of Moose Jaw #161
Bob Wilson	Councillor	Rural Municipality of McKillop #220
Ernie Gutzke	Councillor	Rural Municipality of Francis #127
Rod Benroth	Public Works	Rural Municipality of Sherwood #159
Doug Hogemann	Mayor	Village of St. Gregor
Workshop Staff		
Robert Black		Black Shield Preparedness Services
Dr. David Sauchyn		PARC, University of Regina
Duane Haave	General Manager	WUQWATR
Jillian Scott	Administrator	WUQWATR

APPENDIX D: DR. DAVID SAUCHYN PRESENTATION

Climate Scenarios and Impacts for Saskatchewan

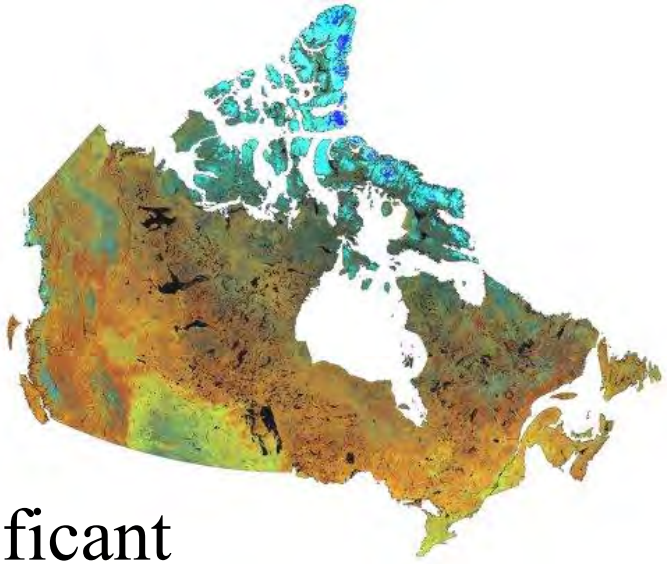
Dave Sauchyn, Prairie Adaptation Research Collaborative, U of R

Climate Extremes Planning Workshop, Regina, February 8, 2012

What is climate change?

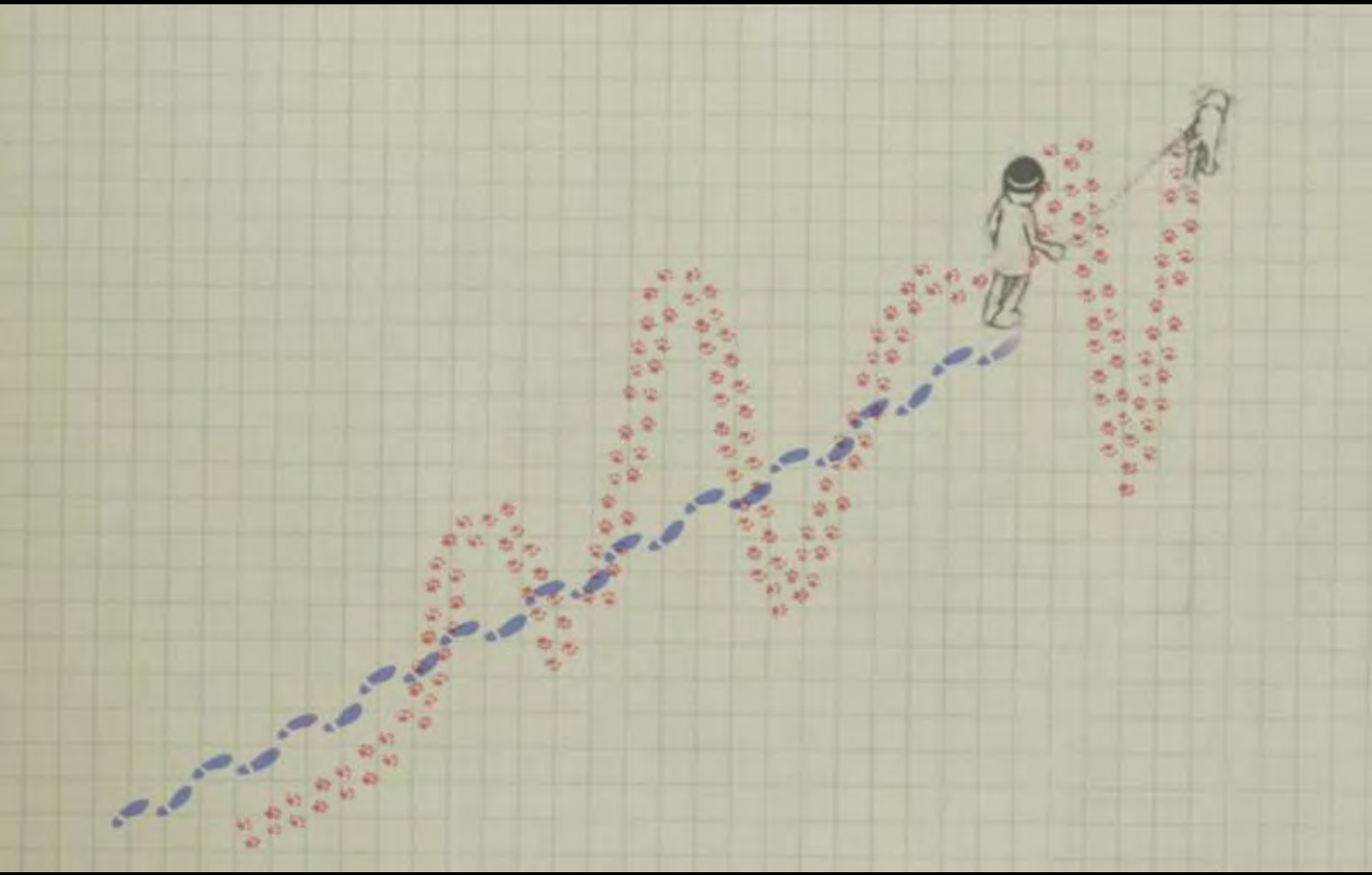
Climate: from *klima* (ancient Greek) meaning inclination:
a tendency, characteristic likelihood

- climate is the statistics of weather
- "weather is what we get,
  climate is what we expect"

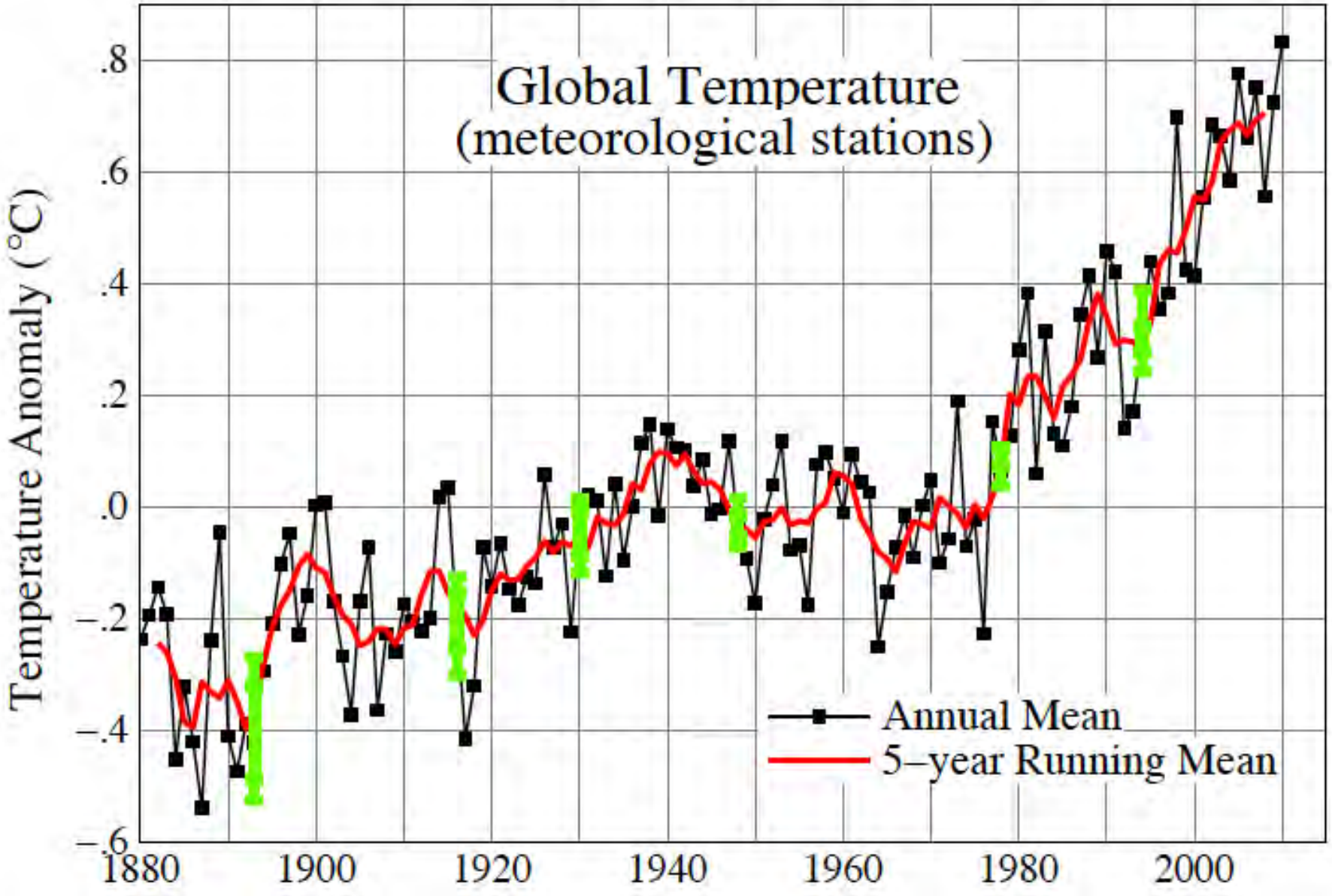


Climate change: a statistically significant variation in the mean climate or in its variability, persisting for an extended period (decades or longer).

"to about 1960, it was generally assumed for all practical purposes and decisions climate could be considered constant"
-Lamb, H.H., 1982: *Climate, History and the Modern World*.



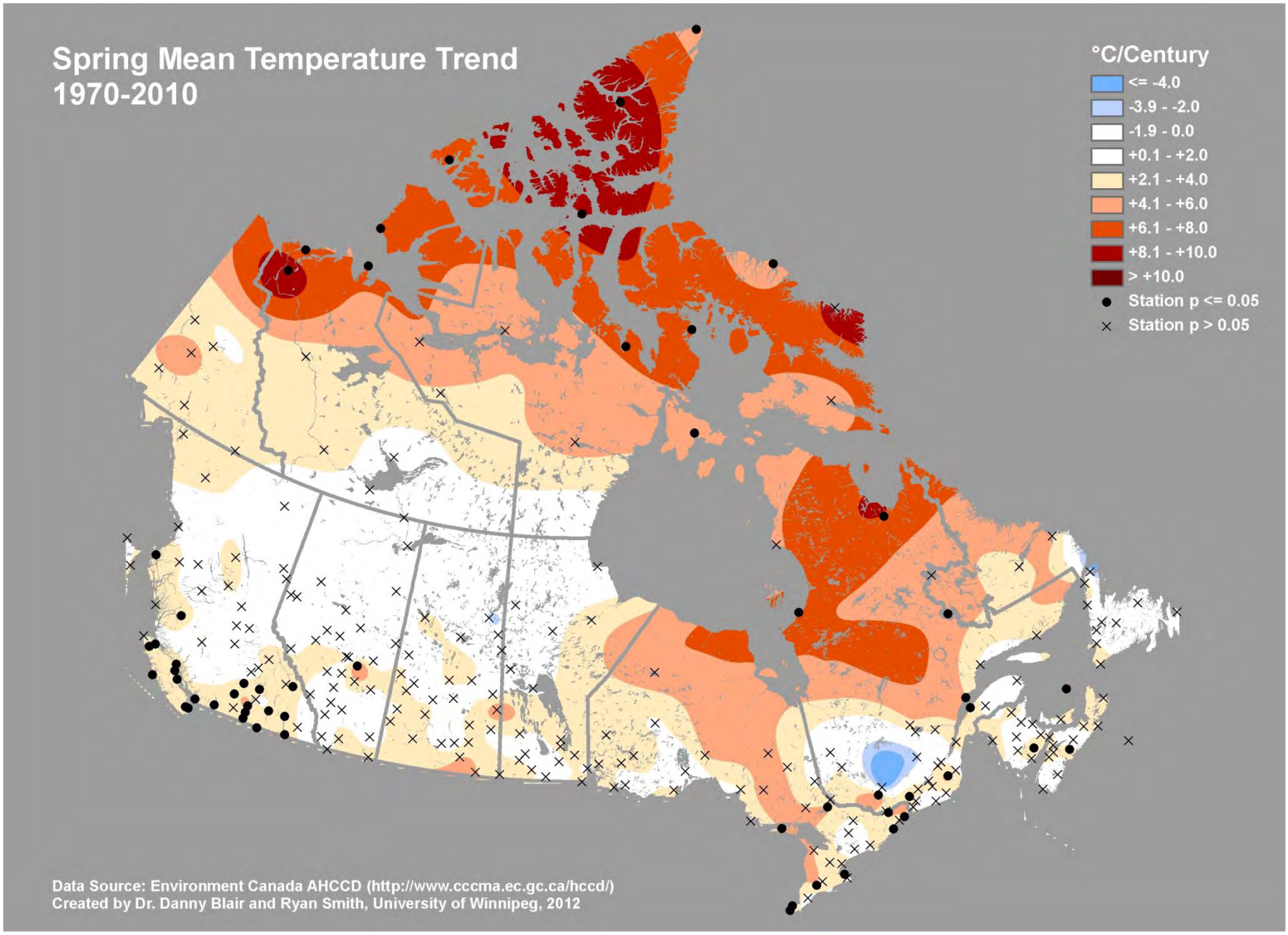
www.youtube.com/

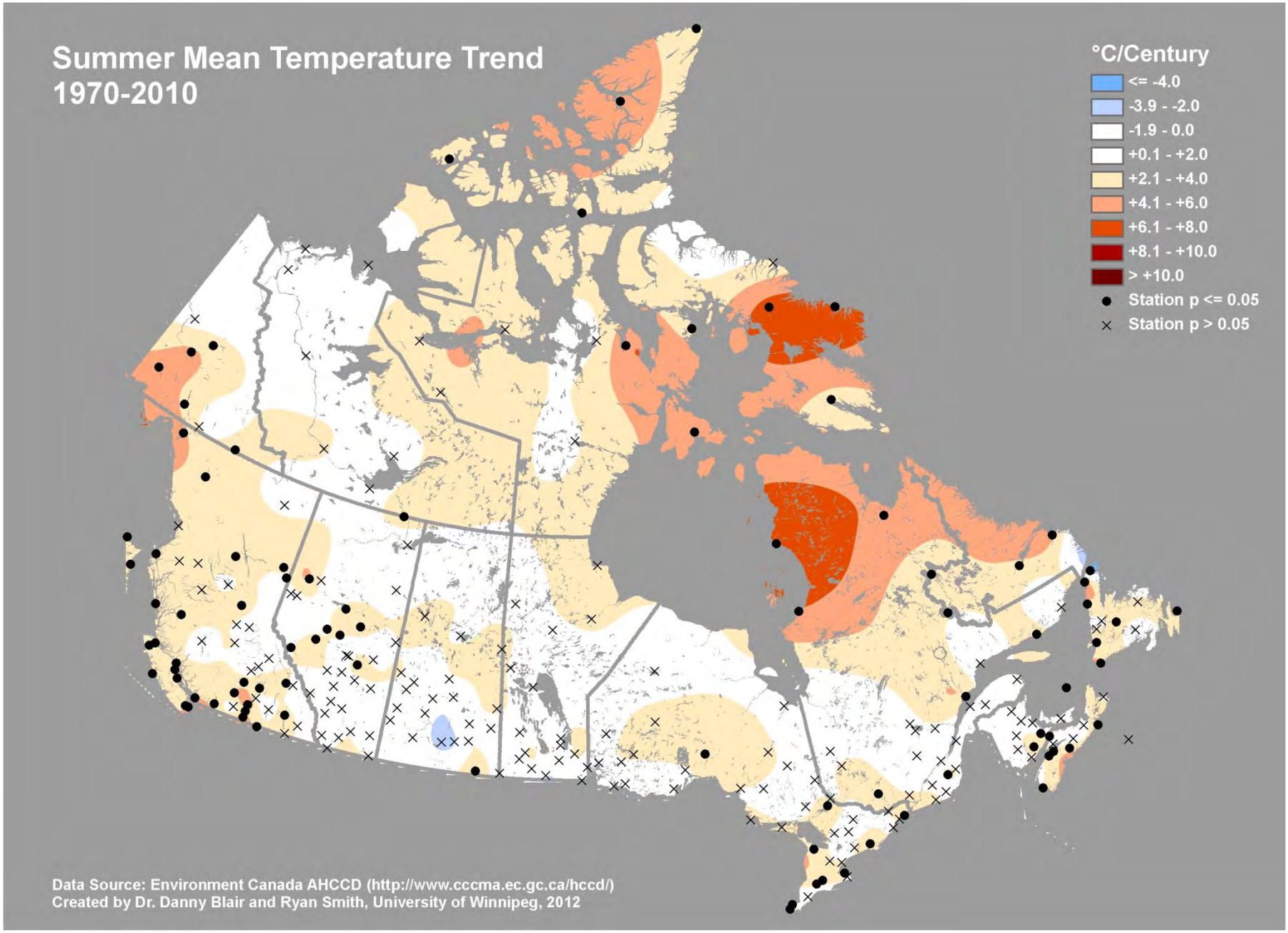


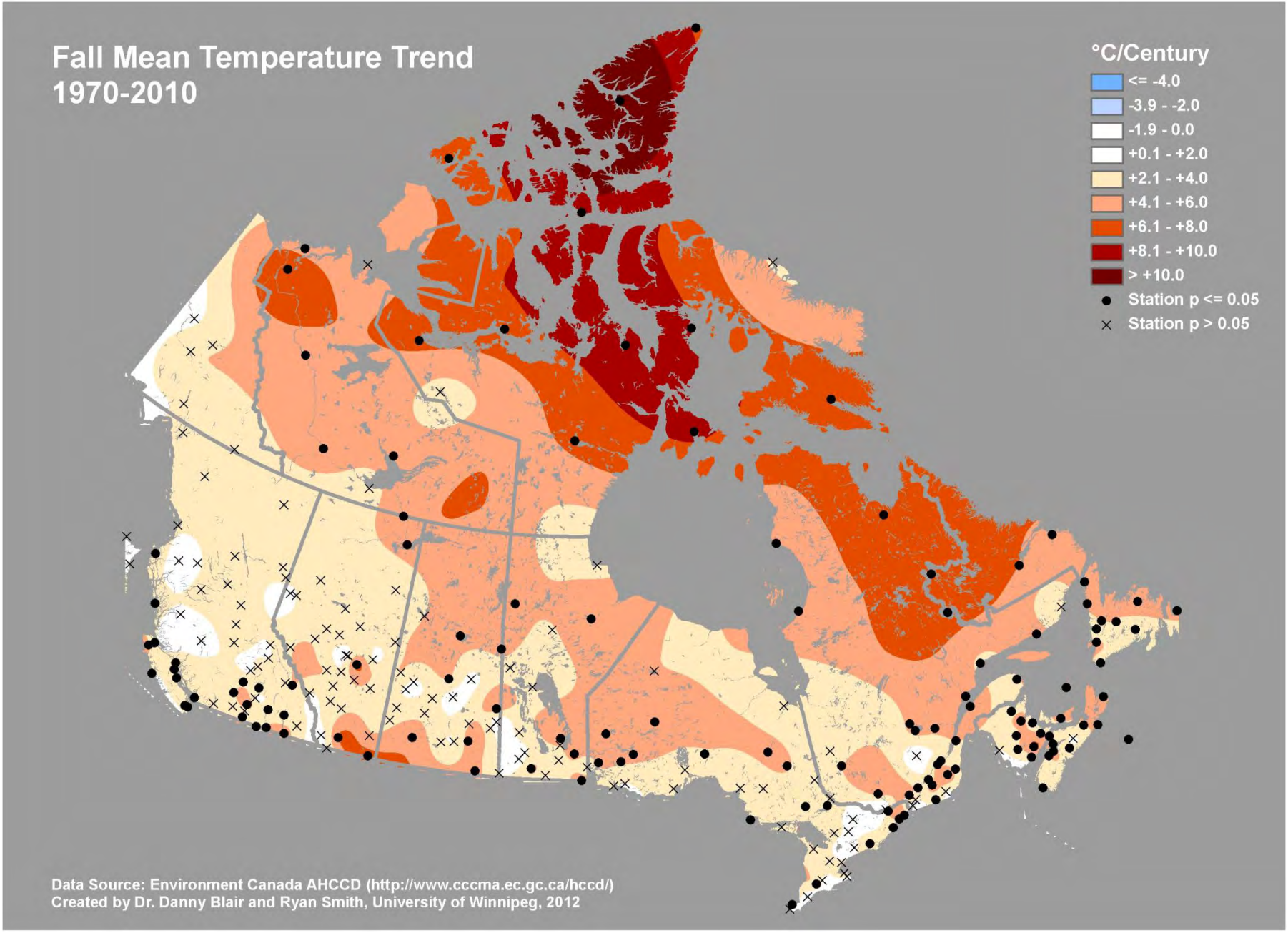
Source: http://data.giss.nasa.gov/gistemp/graphs/

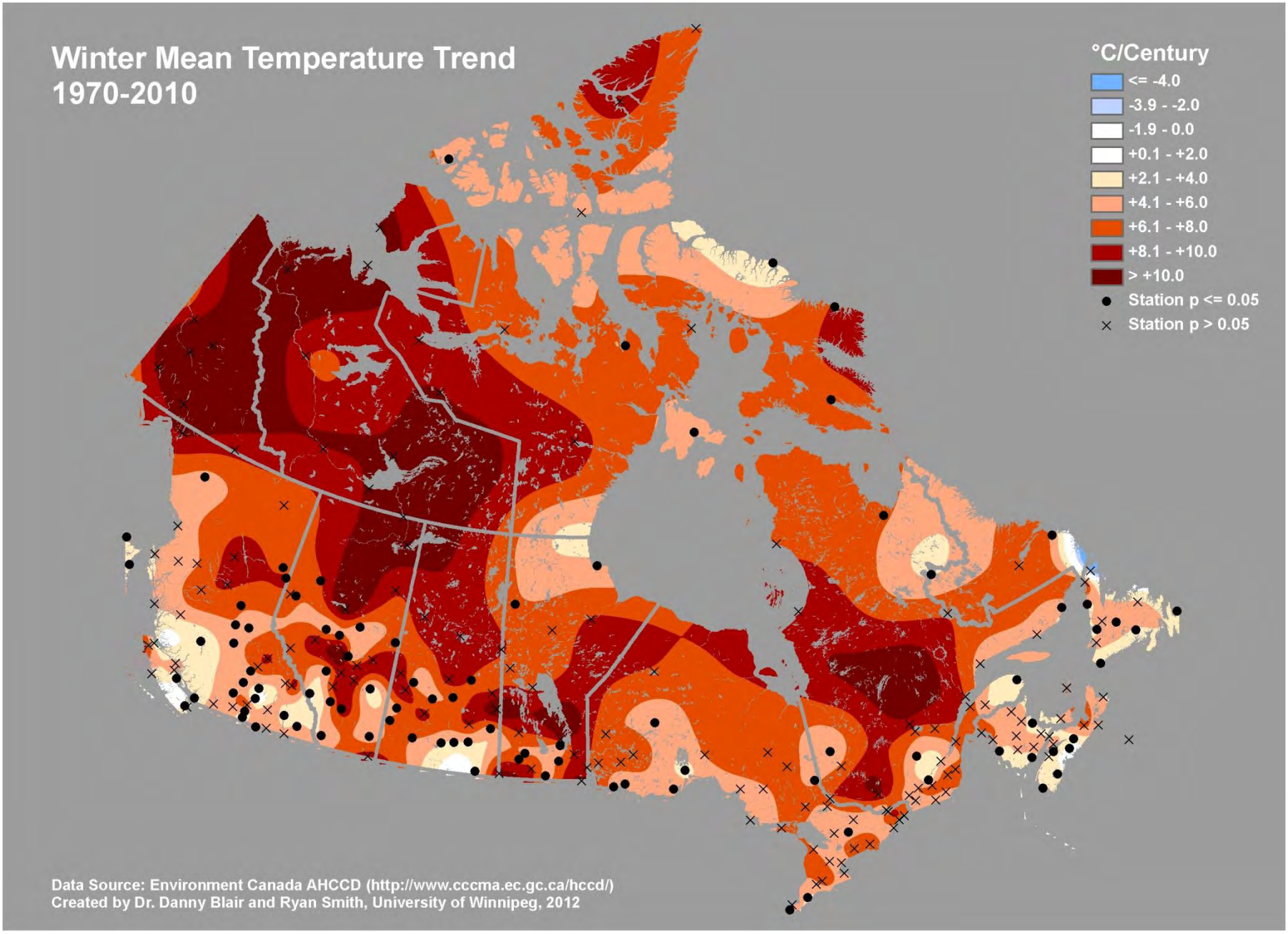
Global Top 10 Warmest Years (Jan-Dec)	Anomaly °C	Anomaly °F
2010	0.62	1.12
2005	0.62	1.12
1998	0.60	1.08
2003	0.58	1.04
2002	0.58	1.04
2009	0.56	1.01
2006	0.56	1.01
2007	0.55	0.99
2004	0.54	0.97
2001	0.52	0.94

http://www.ncdc.noaa.gov/sotc/global/2010/13


Spring Mean Temperature Trend
1970-2010
°C/Century
<= -4.0
-3.9 - -2.0
-1.9 - 0.0
+0.1 - +2.0
+2.1 - +4.0
+4.1 - +6.0
+6.1 - +8.0
+8.1 - +10.0
> +10.0
Station p <= 0.05
Station p > 0.05
Data Source: Environment Canada AHCCD (http://www.cccma.ec.gc.ca/hccd/)
Created by Dr. Danny Blair and Ryan Smith, University of Winnipeg, 2012

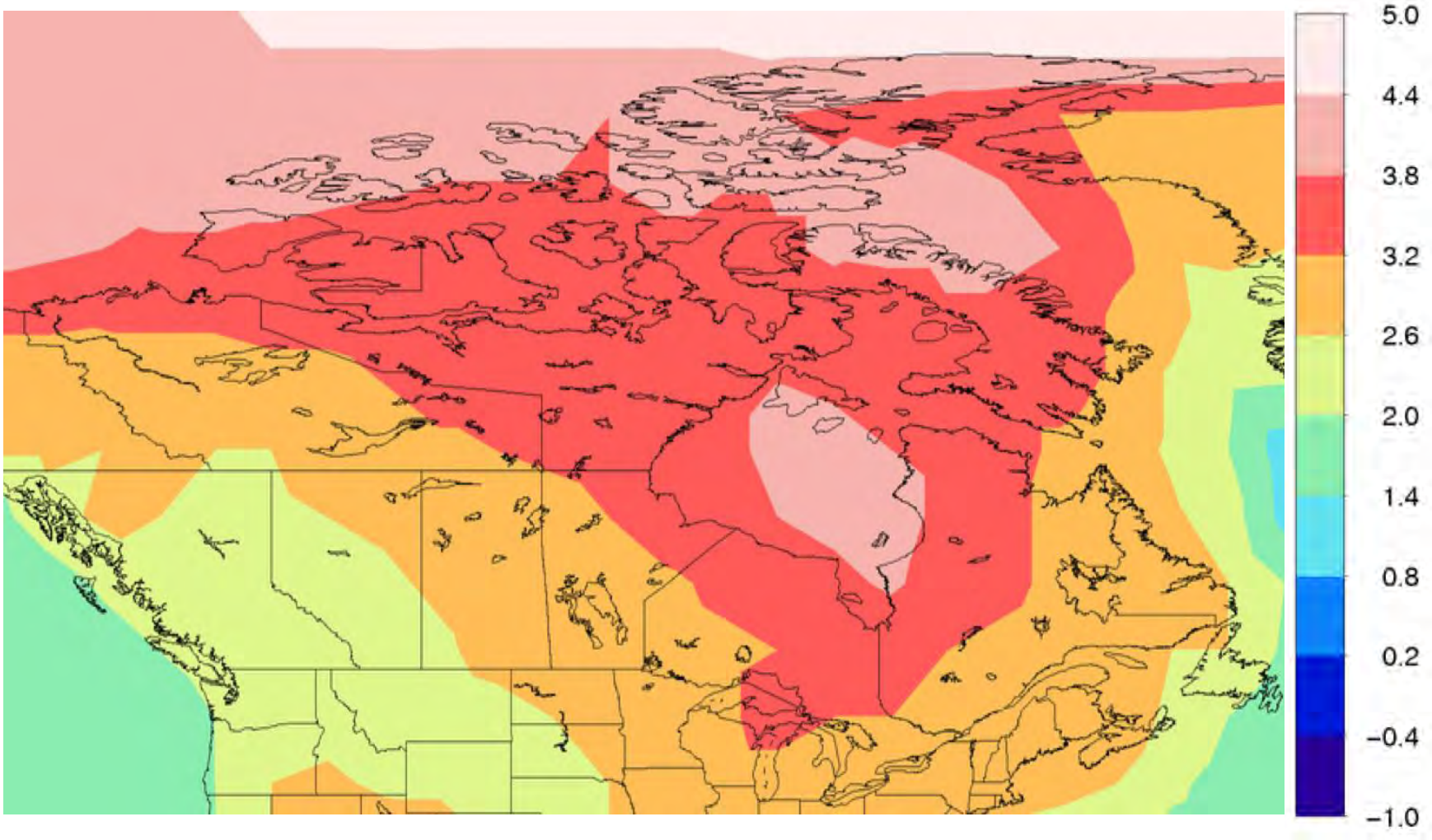

Summer Mean Temperature Trend
1970-2010
°C/Century
<= -4.0
-3.9 - -2.0
-1.9 - 0.0
+0.1 - +2.0
+2.1 - +4.0
+4.1 - +6.0
+6.1 - +8.0
+8.1 - +10.0
> +10.0
Station p <= 0.05
Station p > 0.05
Data Source: Environment Canada AHCCD (http://www.cccma.ec.gc.ca/hccd/)
Created by Dr. Danny Blair and Ryan Smith, University of Winnipeg, 2012


Fall Mean Temperature Trend
1970-2010
°C/Century
<= -4.0
-3.9 - -2.0
-1.9 - 0.0
+0.1 - +2.0
+2.1 - +4.0
+4.1 - +6.0
+6.1 - +8.0
+8.1 - +10.0
> +10.0
Station p <= 0.05
Station p > 0.05
Data Source: Environment Canada AHCCD (http://www.cccma.ec.gc.ca/hccd/)
Created by Dr. Danny Blair and Ryan Smith, University of Winnipeg, 2012

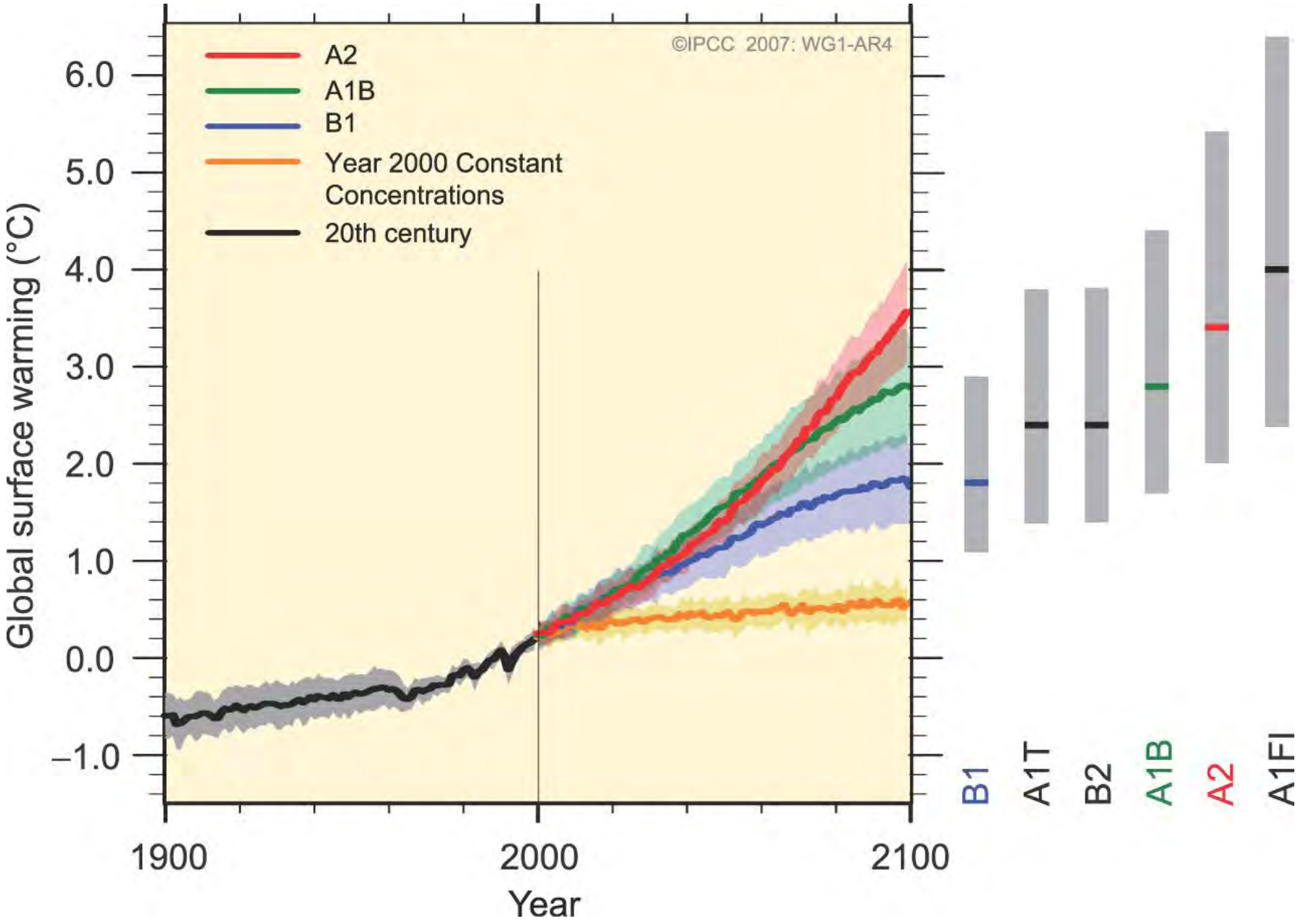

Winter Mean Temperature Trend
1970-2010
°C/Century
<= -4.0
-3.9 - -2.0
-1.9 - 0.0
+0.1 - +2.0
+2.1 - +4.0
+4.1 - +6.0
+6.1 - +8.0
+8.1 - +10.0
> +10.0
Station p <= 0.05
Station p > 0.05
Data Source: Environment Canada AHCCD (http://www.cccma.ec.gc.ca/hccd/)
Created by Dr. Danny Blair and Ryan Smith, University of Winnipeg, 2012

Difference in Mean Annual Air Temperature (° C)

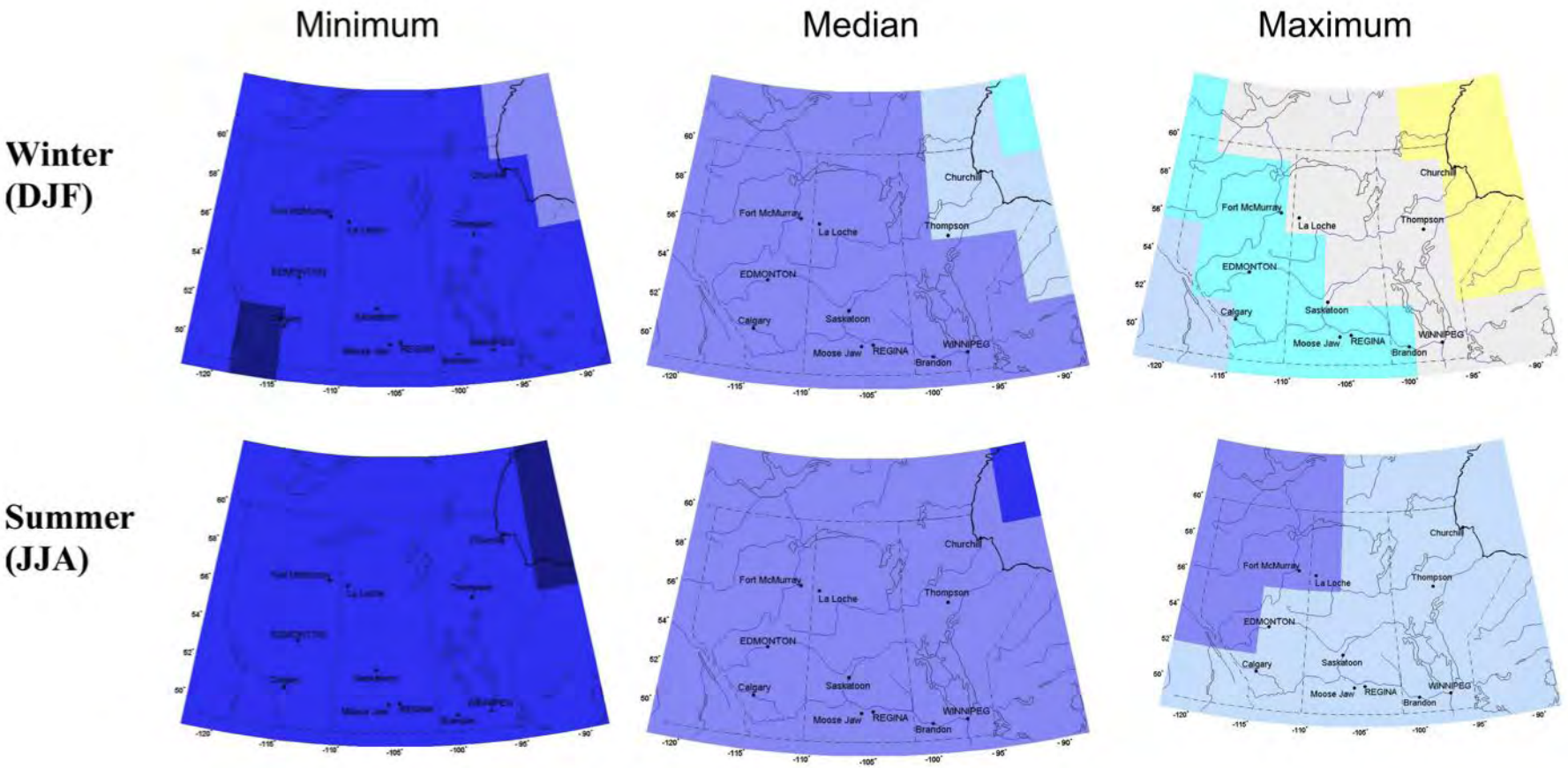
between 2041-70 and 1961-90, CGCM3T47 (SR-A1B)



Source: www.ccsn.ca

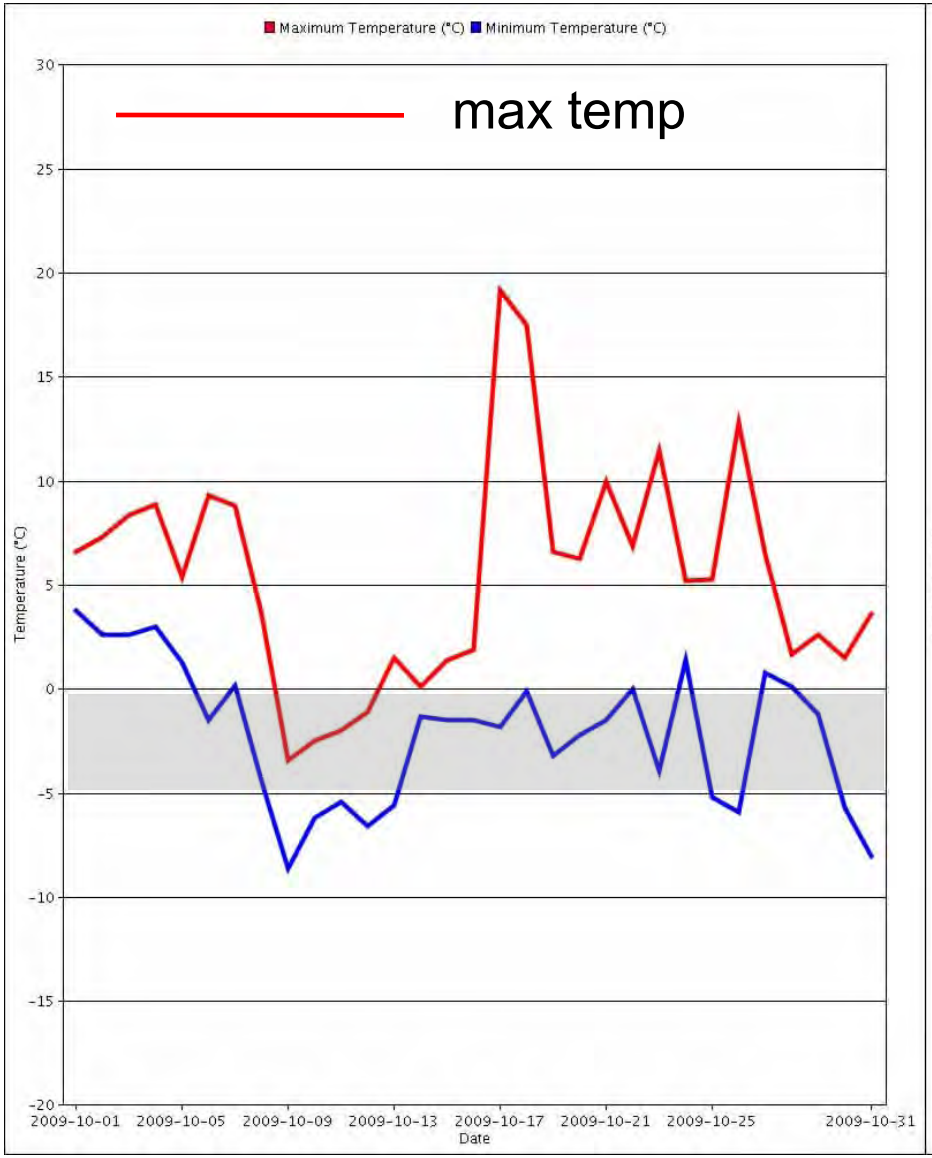

©IPCC 2007: WG1-AR4
A2
A1B
B1
Year 2000 Constant Concentrations
20th century
Global surface warming (°C)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
–1.0
1900
2000
2100
Year
B1
A1T
B2
A1B
A2
A1FI

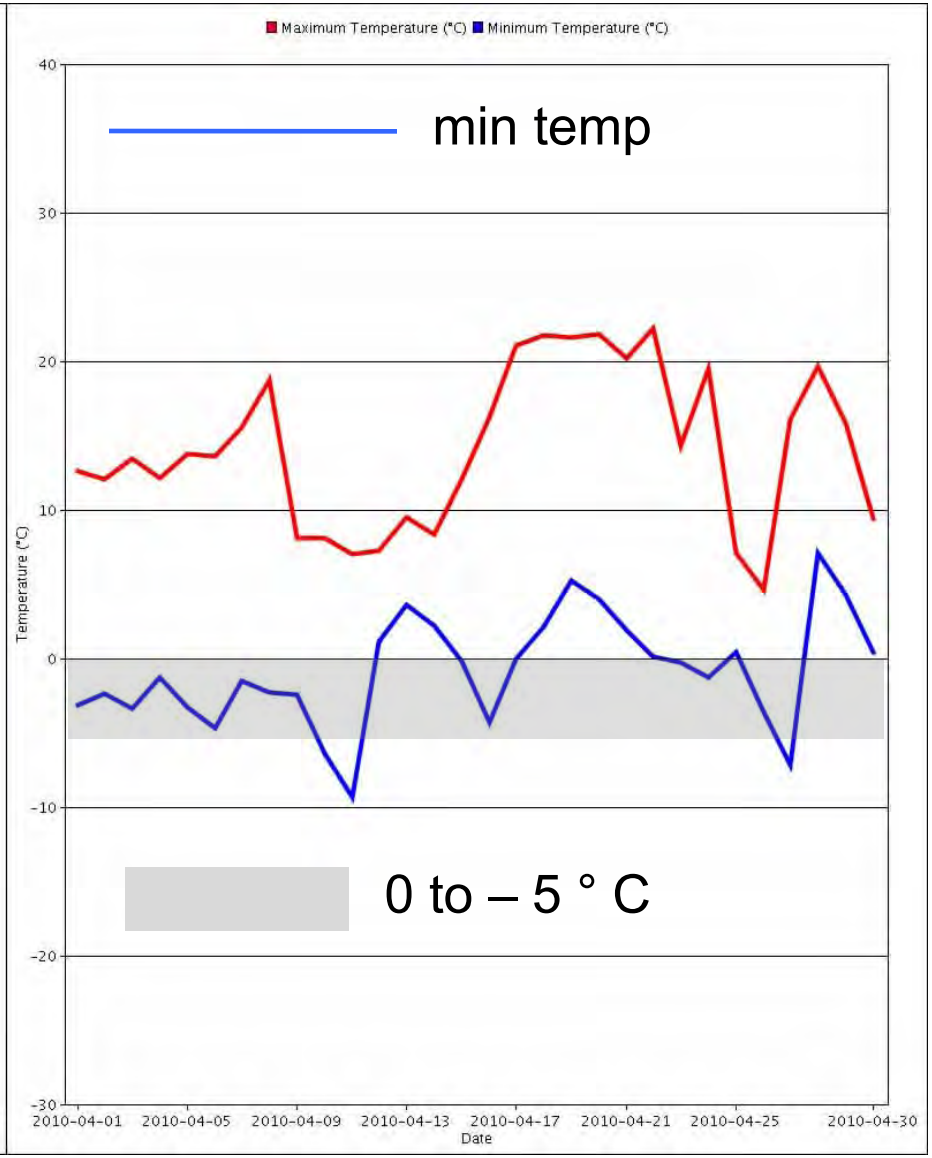
Seasonal Temperature Scenarios, 2050s



Barrow 2010

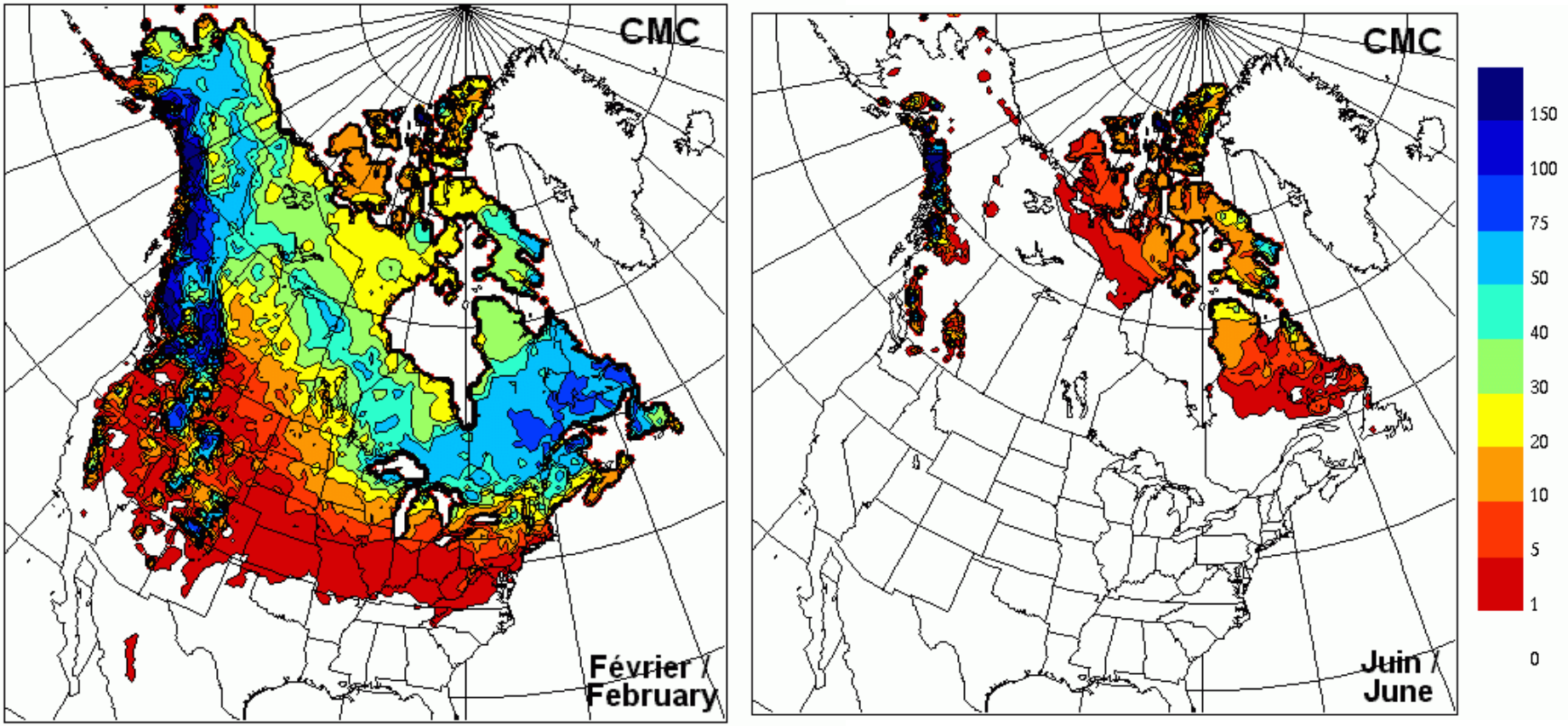
Regina, fall (Oct 09) and spring (Apr 10) daily temperatures





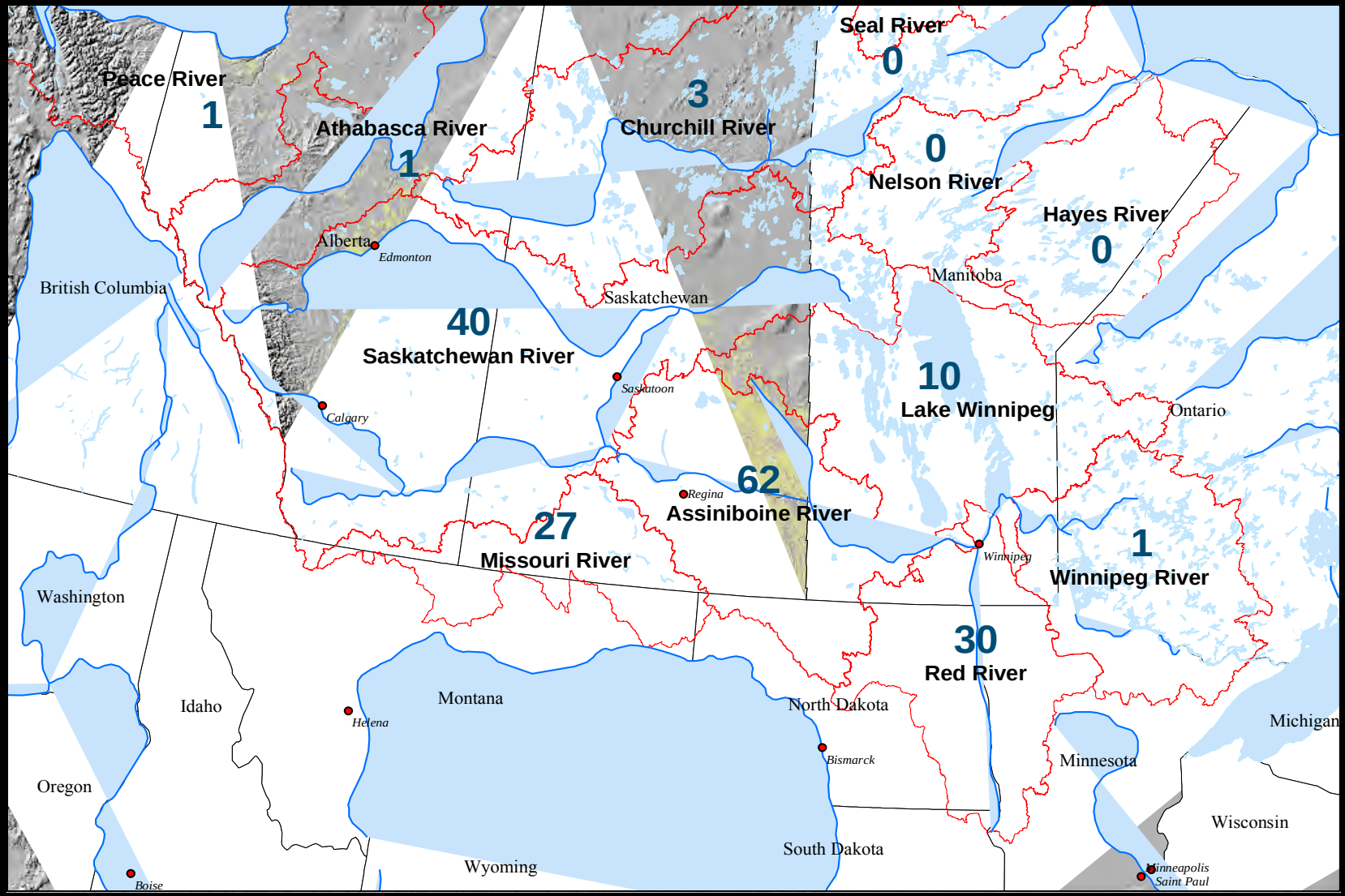
We are losing the advantage of a cold winter

Mean Snow Depth, 1979-96



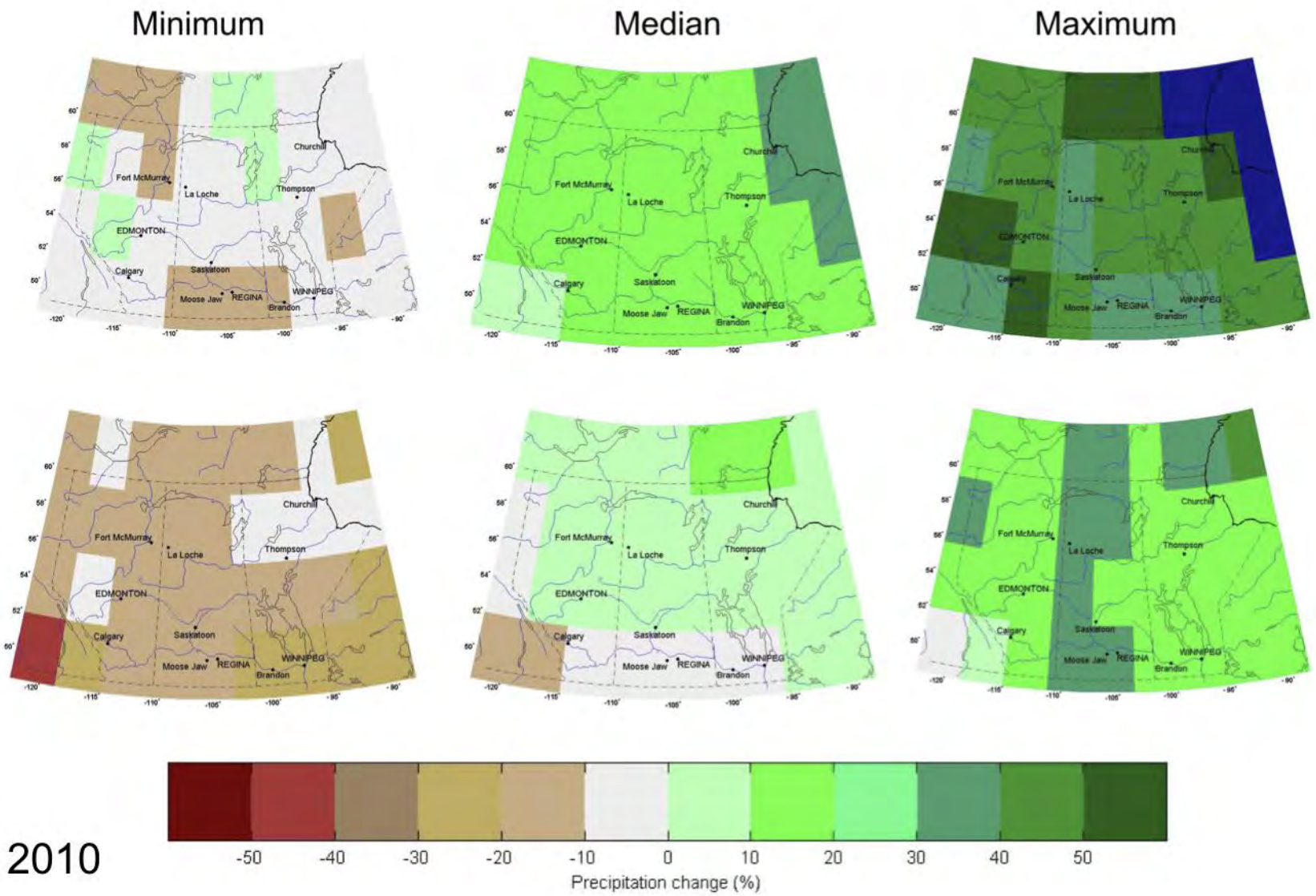
Brown et al. 2003; www.ccin.ca/cms/en/socc/snow/snowAtlas.aspx

Prairie Drainage Basins



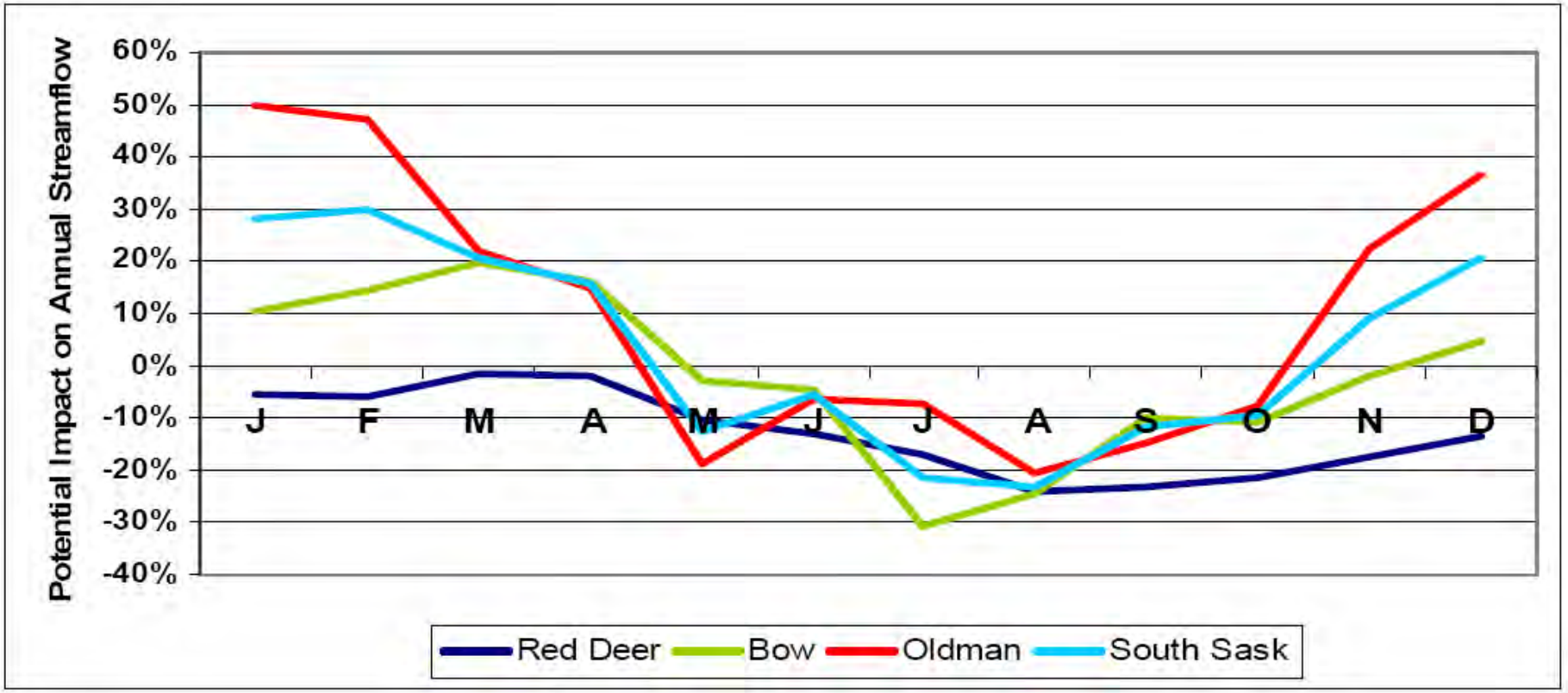
(source: AESB – formerly PFRA)

Seasonal Precipitation Scenarios, 2050s

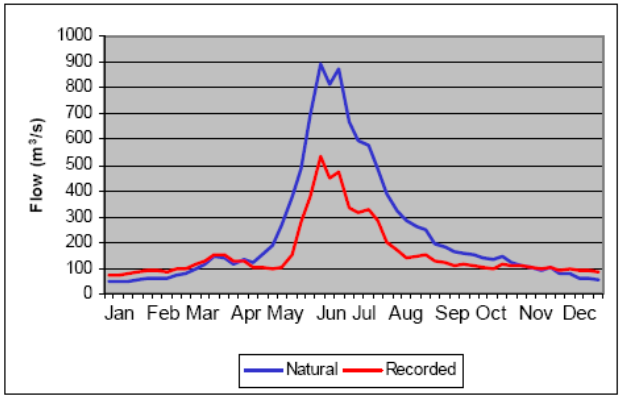


Barrow 2010

Climate Change* (%) Impacts on Natural Flows in the SSRB



* 2040-69 vs 1961-90



AMEC. 2009. South Saskatchewan River Basin in Alberta: Water Supply Study. Alberta Agriculture and Rural Development.
Martz et al. (2007)

Legacy Project Potash Mine

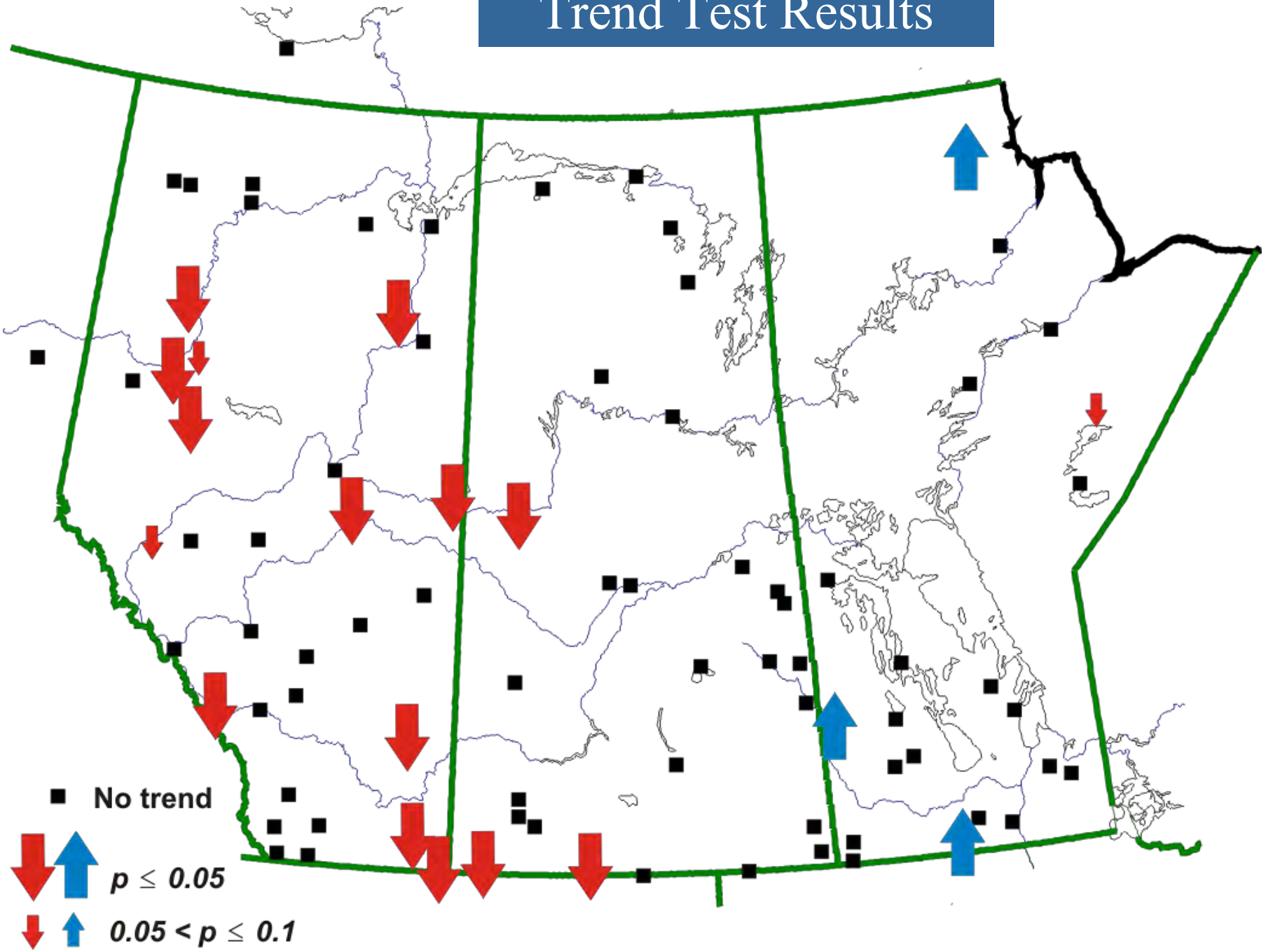
will produce between three and four million tonnes of potash per year using *solution* mining techniques

Saskatchewan's first new potash mine in nearly 40 years

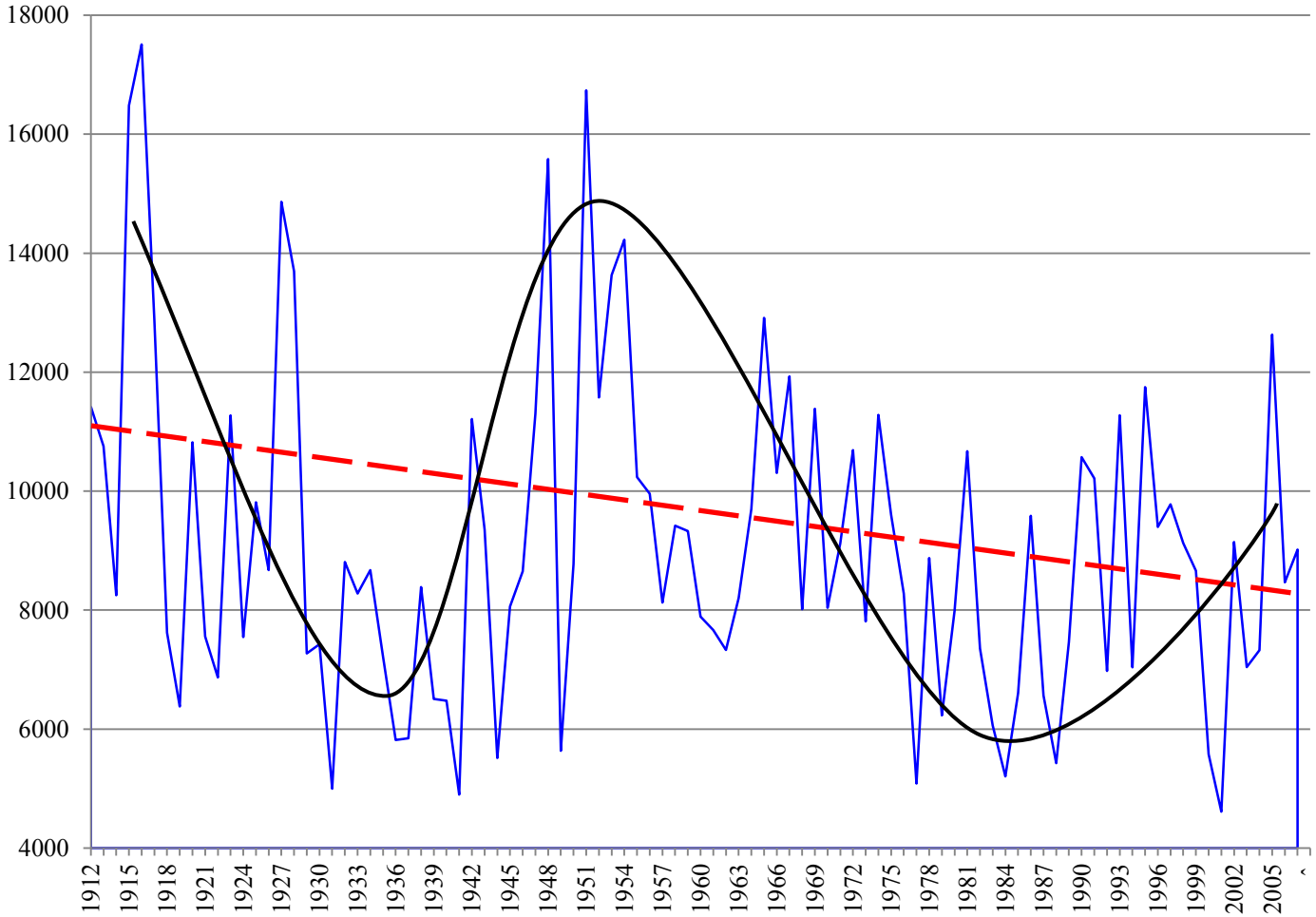
"The Project is expected to result in a 3.4% decrease in the **annual runoff volume** from the local watershed."

- Environmental Impact Statement, Saskatchewan Ministry of Environment, August 2010

Trend Test Results



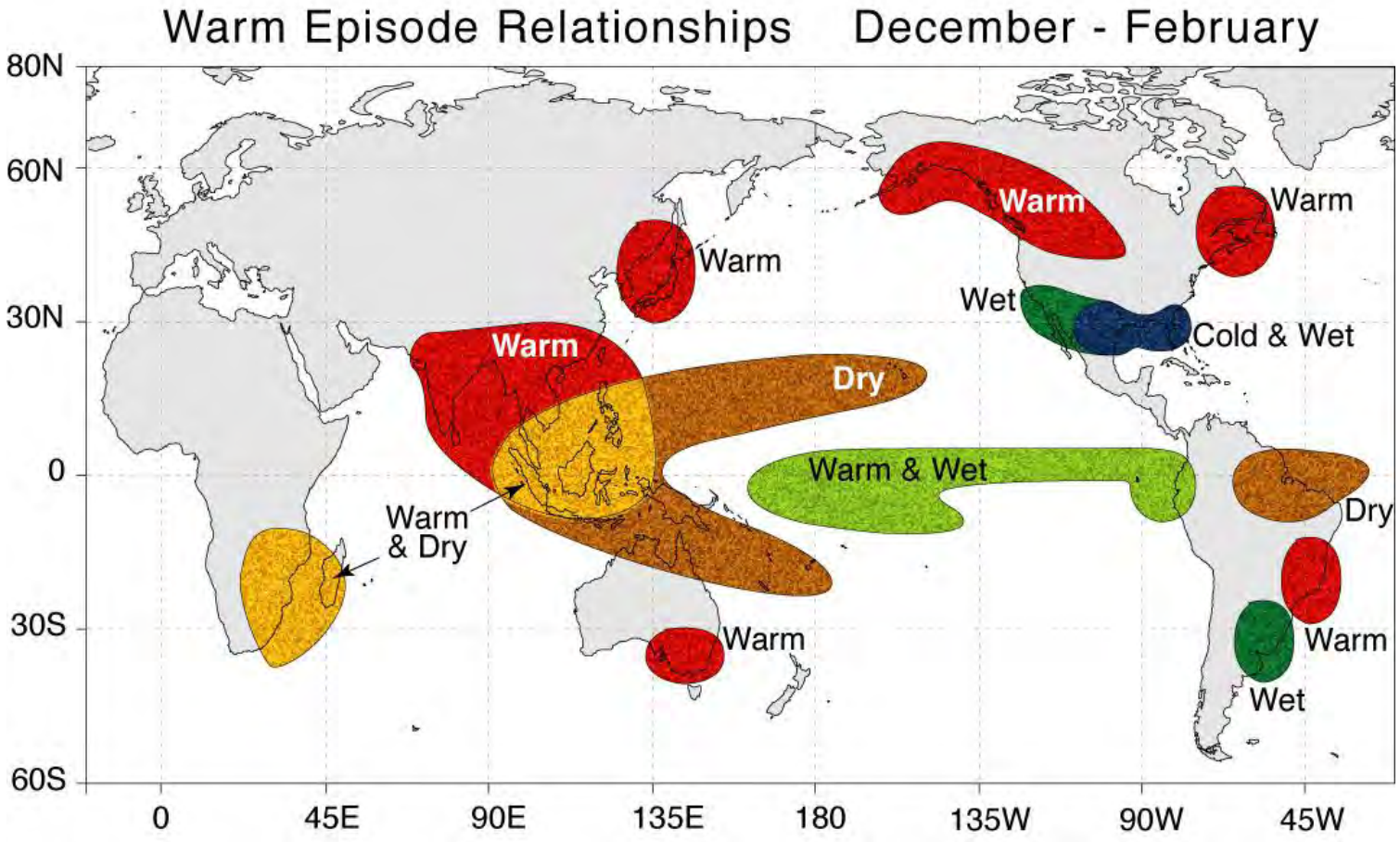
Annual natural flow, South Saskatchewan River at Medicine Hat



source: PPWB

El Niño remote impacts: Teleconnections

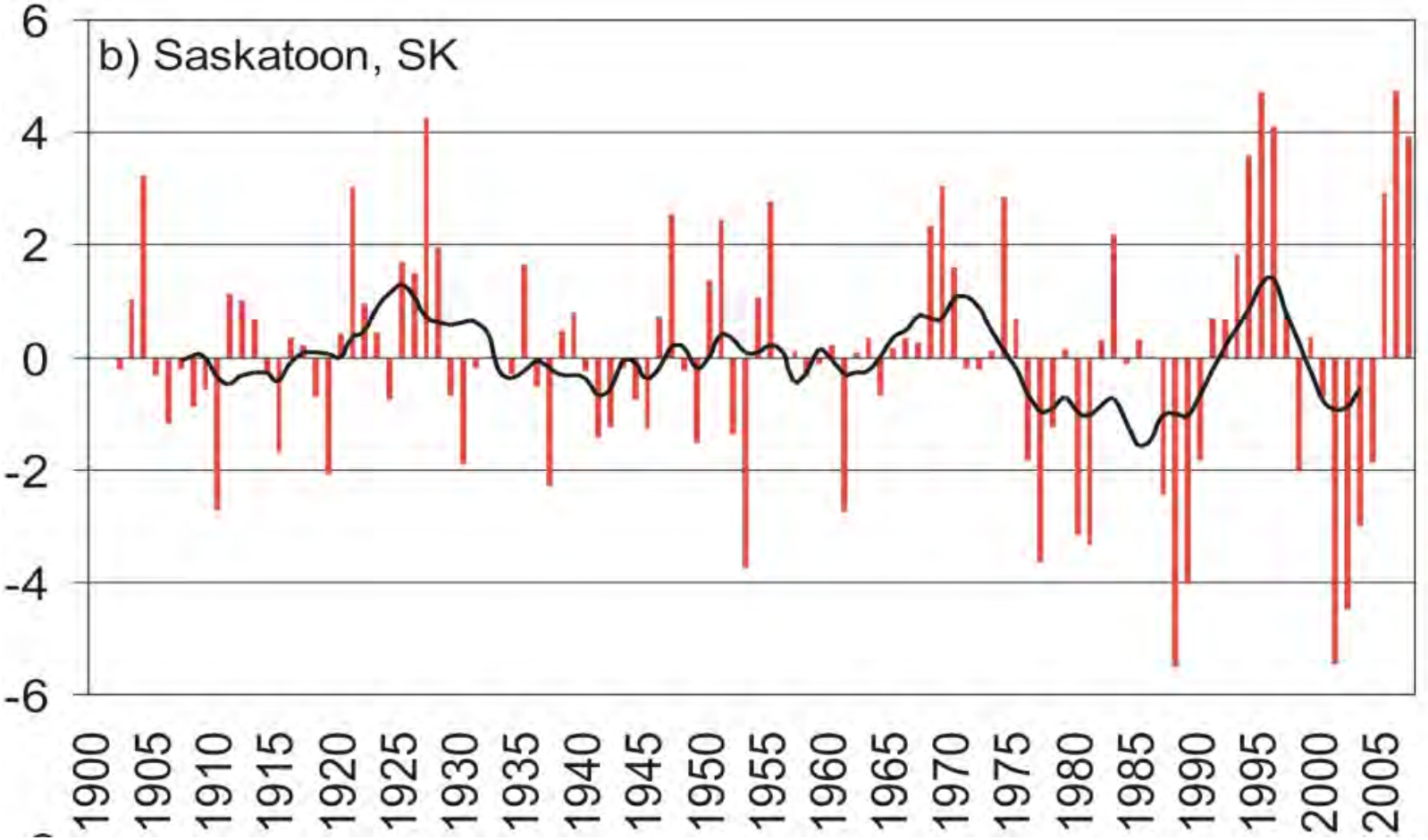
La Niña teleconnections have the opposite effect



Neelin, 2011. *Climate Change and Climate Modeling*, Cambridge UP

skfloods.ca

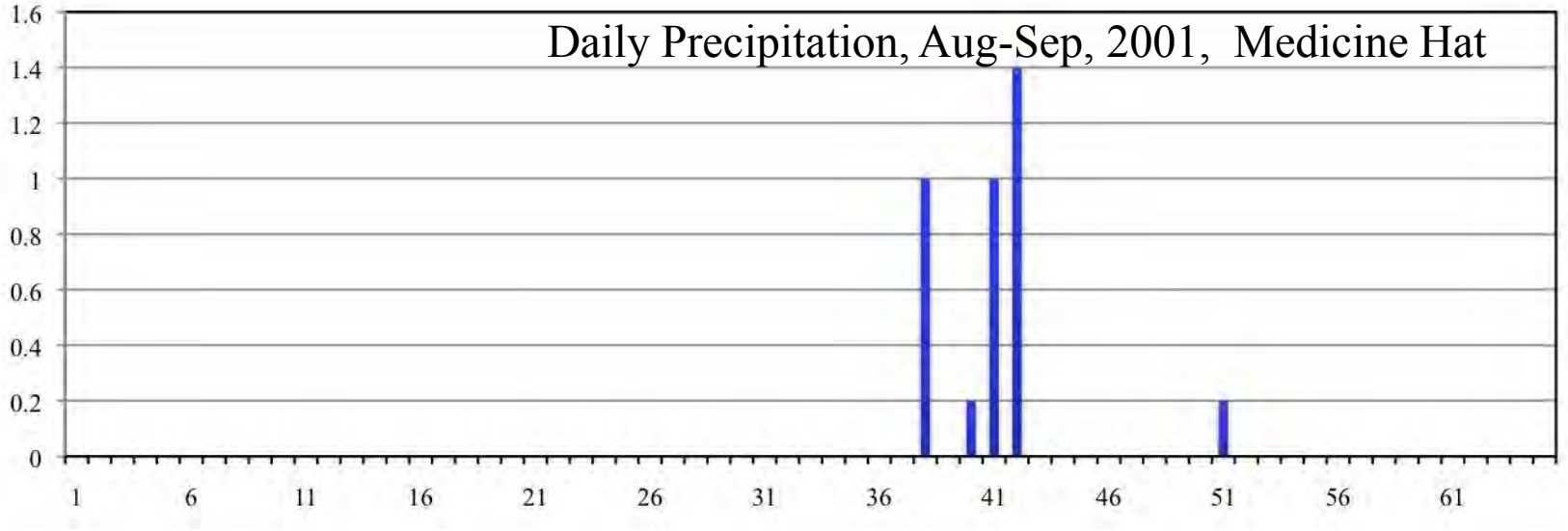
Palmer Drought Severity, Saskatoon, 1900 - 2007



Bonsal et al., 2011; Sauchyn and Bonsal, in press

May 30, 1961:
> 250 mm in <
one hour

July 3, 2000:
330 mm in
eight hours

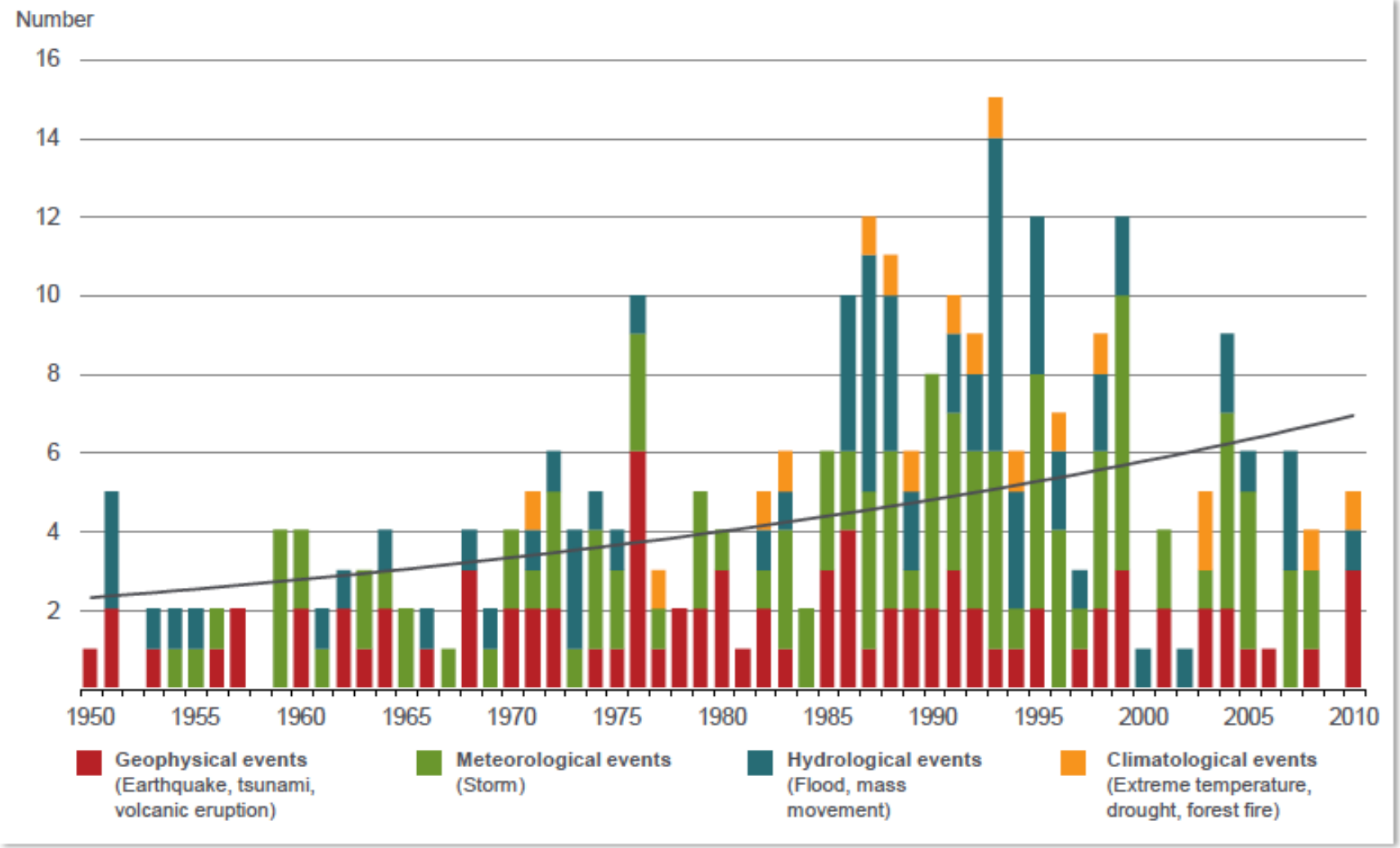


NatCatSERVICE

Great natural catastrophes worldwide 1950 – 2010

Number of events with trend

Munich RE



LETTER NATURE VOL 470, 17 FEBRUARY 2011

doi:10.1038/nature09763

Human contribution to more-intense precipitation extremes

Seung-Ki Min[1], Xuebin Zhang[1], Francis W. Zwiers[1] & Gabriele C. Hegerl[2]

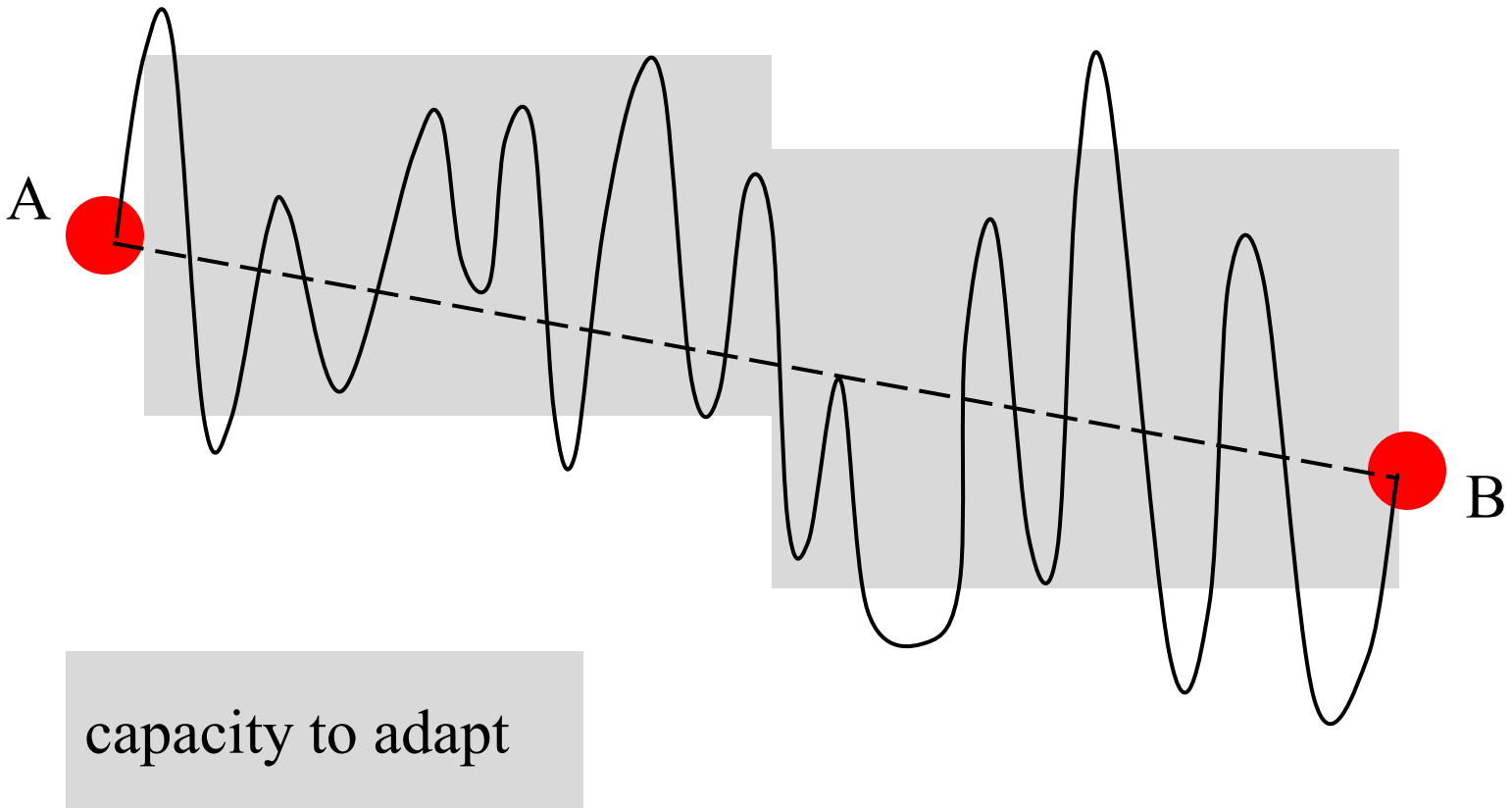
[1]Climate Research Division, Environment Canada, Toronto, Ontario, Canada.

- atmospheric **water-holding capacity** is expected to increase roughly exponentially with temperature

- human-induced increases in greenhouse gases have contributed to the observed **intensification of heavy precipitation** events found over approximately two-thirds of data-covered parts of Northern Hemisphere land areas

The major climate change impacts are shifts in the distribution of water resources and ecosystems

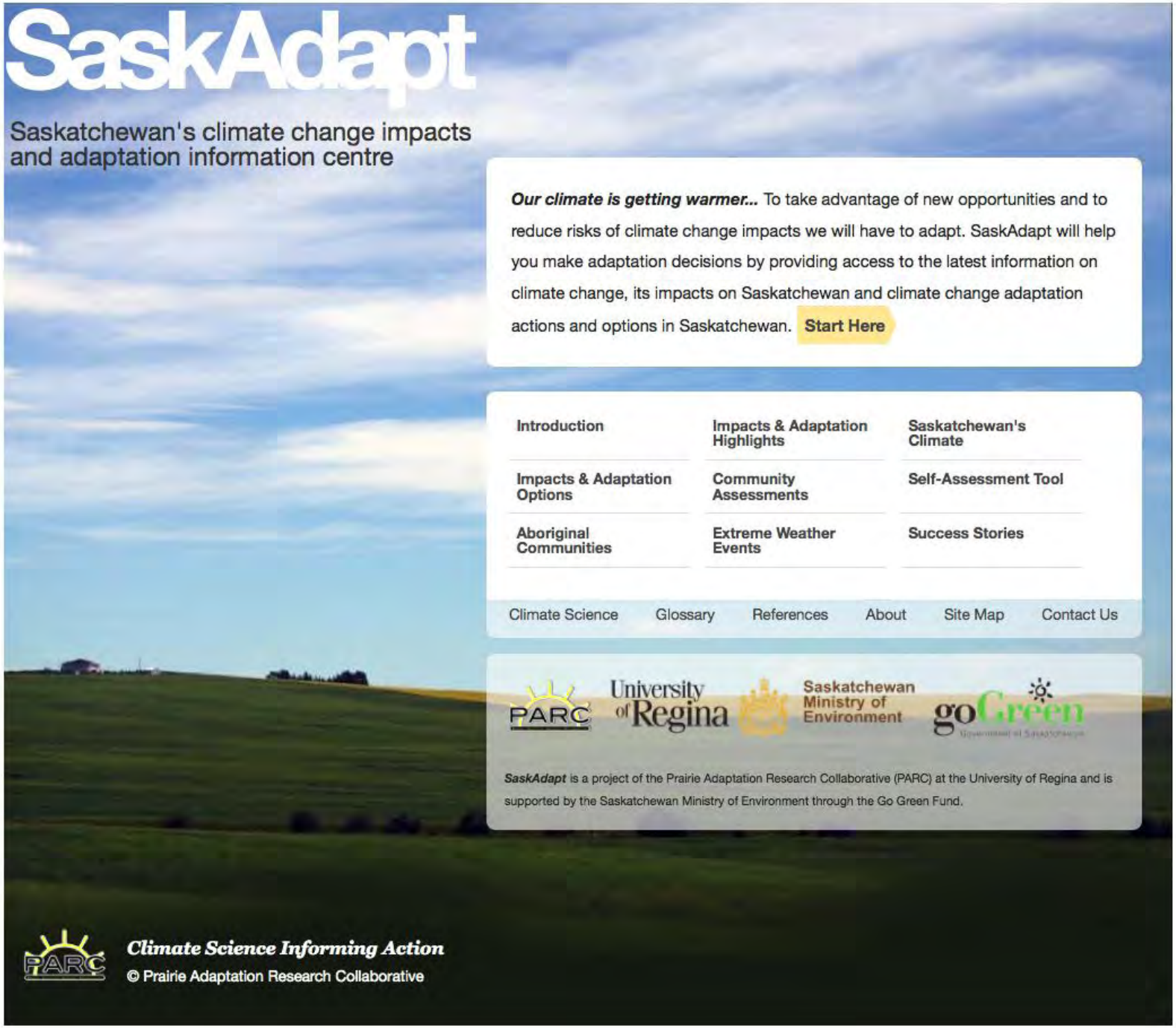
Adaptation to Climate Variability and Change



Adaptation: adjustments in practices, processes, or structures of systems to projected or actual changes of climate

The **Prairie Adaptation Research Collaborative** (PARC) is a partnership of the governments of Canada, **Alberta**, Saskatchewan and Manitoba mandated to pursue climate change impacts and adaptation research in the Prairie Provinces.

- Alberta Vulnerability Assessment Project
- Saskatchewan's Natural Capital and Climate Change
- Prairies Chapter, National Assessment of Climate Change Impacts and Adaptation
- Prairies Regional Adaptation Collaborative (**Prairies RAC**)


SaskAdapt
Saskatchewan's climate change impacts and adaptation information centre
Our climate is getting warmer... To take advantage of new opportunities and to reduce risks of climate change impacts we will have to adapt. SaskAdapt will help you make adaptation decisions by providing access to the latest information on climate change, its impacts on Saskatchewan and climate change adaptation actions and options in Saskatchewan. Start Here
Introduction
Impacts & Adaptation Highlights
Saskatchewan's Climate
Impacts & Adaptation Options
Community Assessments
Self-Assessment Tool
Aboriginal Communities
Extreme Weather Events
Success Stories
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SaskAdapt is a project of the Prairie Adaptation Research Collaborative (PARC) at the University of Regina and is supported by the Saskatchewan Ministry of Environment through the Go Green Fund.
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SaskAdapt

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Moose Jaw
Moose Mountain
North Battleford
Regina
Prince Albert
Saskatoon
Stoney Rapids
Swift Current
Weyburn
Yorkton

Community Assessments and Adaptation

View larger map

- Cypress Hills
- La Ronge
- Prince Albert
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SaskAdapt » Community Assessments » Regina

Search Go!

Regina

Community Assessment & Adaptation Options:

Regina is located in south-central Saskatchewan along Wascana Creek within the Moist Mixed Grassland Ecoregion. Regina is Saskatchewan's second largest city, the provincial capital, and a thriving manufacturing, retail, service and distribution centre. The city largely relies on its water supply from Buffalo Pound Lake, which in turn is fed from Lake Diefenbaker along the South Saskatchewan River system. Treated wastewater is released into the Qu'Appelle River system. The urban forest has been planted, and streets lined by American Elm (Figure 2) are a significant attraction as is the recently dredged Wascana Lake. Wascana Centre is a 376 hectare park on Wascana Lake and encompasses numerous tourist attractions of provincial stature: the Legislature, Science Centre/Imax Theatre, Royal Saskatchewan Museum, McKenzie Art Gallery and the University of Regina. Regina provides other major tourism and entertainment attractions year-round including Agribition, Farm Progress Show, Casino Regina and the Saskatchewan Roughriders football club.

Figure 1: Location of Regina, Moist Mixed Grassland Ecoregion

Learn more:
Calculating Degree-Days

The Moist Mixed Grassland Ecoregion is home to over 55% of the provincial population, and encompasses other major urban centres including Saskatoon, Moose Jaw, Weyburn and Estevan. The ecoregion is dominated by agriculture, being approximately 80% cultivated. Numerous dams and reservoirs are present. Other economic activity includes production of oil and gas, potash, salt and coal. Natural vegetation is primarily mid-grasses and short-grasses with aspen woodlands restricted to sloughs and coulees. Aspen stands have been expanding as a result of a reduced incidence of wildfire. Native habitat and cropland are important wildlife habitat for upland mammals and waterfowl.

Figure 2: American Elm lined streets, Lakeview area of Regina

Climate Normals (1971-2000)

Future Climate

Victoria Park, Regina (Source: Tourism Saskatchewan)

Over the century to 2100 climate scenarios suggest:

- A warmer climate - temperatures may generally rise 2 to 4 degrees.
- A longer growing season - but drier, despite an increase in precipitation to about 400 to 450 mm. This is a result of increased temperatures and increased evapotranspiration.
- The demand for summer cooling could increase almost 2 to 2.5 times.
- A shorter, milder winter. Heating requirements may be reduced by 14% to 22%.
- Expect more frequent and more intense extreme events (e.g. heavy precipitation or drought). Droughts will likely increase in intensity and frequency.
- Expect an increase in the number of freeze/thaw days.

Regional Adaptation Options

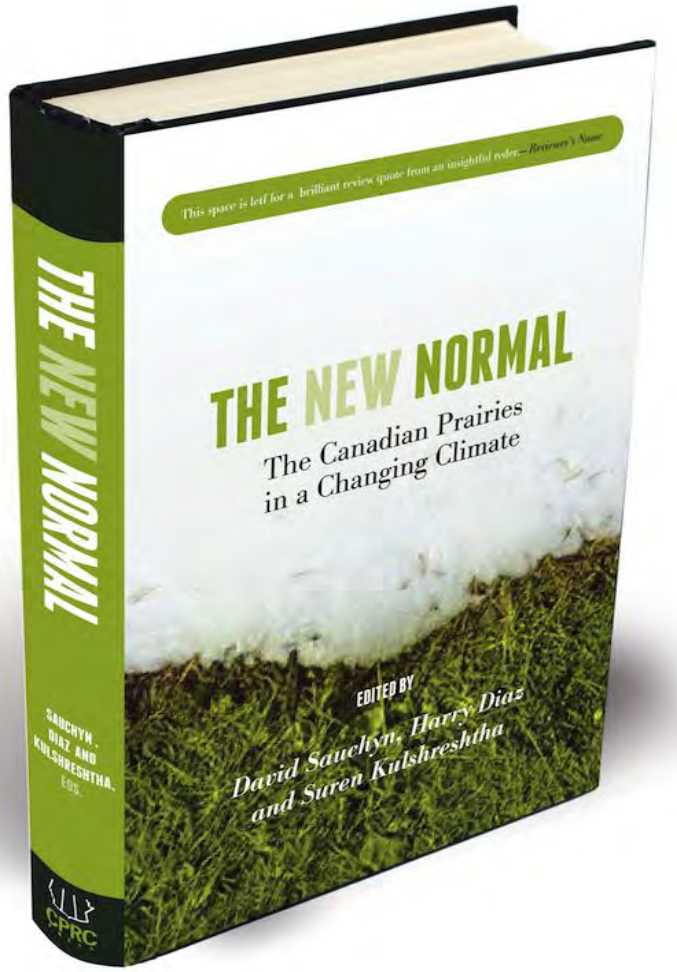
- Under climate change, the primary issue for communities will be water and sewer management to handle both flood and drought situations.
- Xeriscaping (low water landscaping; see City of Regina webpage) and urban forest retention should be priorities. This may require introducing new plant species, changes to irrigation schedules, and pest management adjustments.
- Adopt appropriate road maintenance type and scheduling to minimize surface deterioration associated with more frequent freeze-thaw cycles, and address more frequent icey road conditions.
- Monitor park vegetation and manage for potential increased use.
- Ensure emergency preparedness plans address extreme weather events (such as heat waves) and associated health risks. The city should have a drought management protocol in place.
- Agricultural priorities in the region will continue to be soil and moisture conservation and stocking rates and/or grazing periods may have to be adjusted.
- The outdoor ice rink season will shorten. On the other hand, a longer warm season increases tourism and cultural opportunities.

Sources of Additional Information:

“Adaptation” to Climate Change

Sustainable agriculture
Integrated water resource management
Environmental farm planning
Low impact development
PIEV – public infrastructure and engineering vulnerability
Drought and excess moisture preparedness planning
Adaptive ecosystem management
Source water protection
Soil and water conservation
Continuous cropping practices
Restoration ecology
Sustainable economic development
Natural disaster preparedness
Etc …

PARC


This space is left for a brilliant review quote from an insightful reader.—Reviewer's Name
THE NEW NORMAL
The Canadian Prairies
in a Changing Climate
EDITED BY
David Sauchyn, Harry Diaz
and Suren Kulshreshtha
THE NEW NORMAL
SAUCHYN, DIAZ AND KULSHRESHTHA, EDS.
CPRC

APPENDIX E: ROBERT BLACK PRESENTATION

WUQWATR

Climate Extremes Planning Workshop

Bob Black

BLACK SHIELD
PREPAREDNESS SOLUTIONS INC.

February 2012

Outline

- Overview of the Guide
- The Climate Change Risk Assessment Process
- Risk Assessment Exercise

Overview of the Guide and the Risk Assessment Process

The Guide - Background

- First developed by S.e.i. for Caribbean countries 2003-05 – part of a CIDA project: risk-based, CSA Q850. Published by Caricom- still in use

- In Canada, 2005-2010, sponsored by NRCan for municipalities in ON, AB, BC, Arctic/north

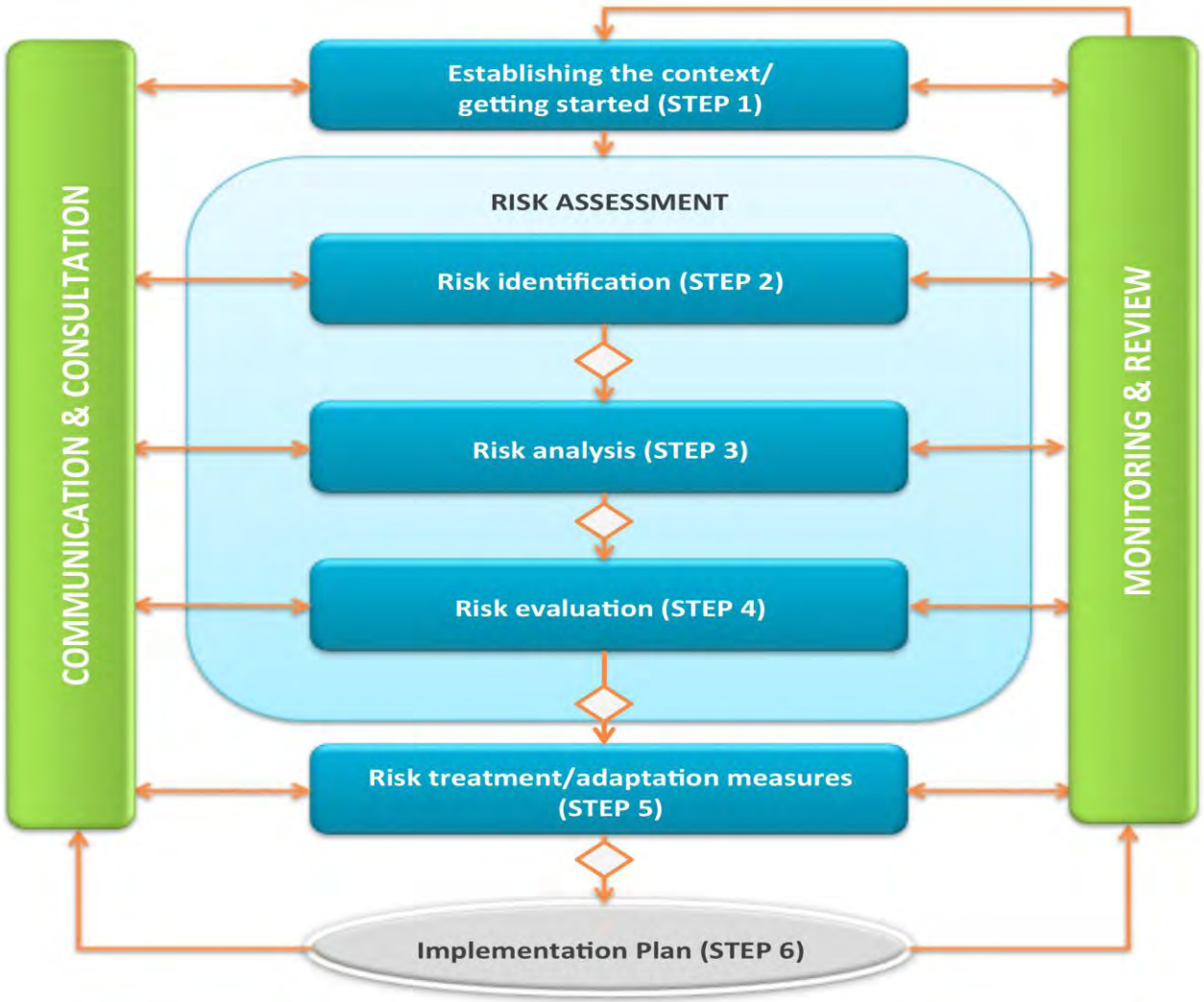
- Now for GoA and later for ON Govt. – new ISO 31000

The Guide - Outline

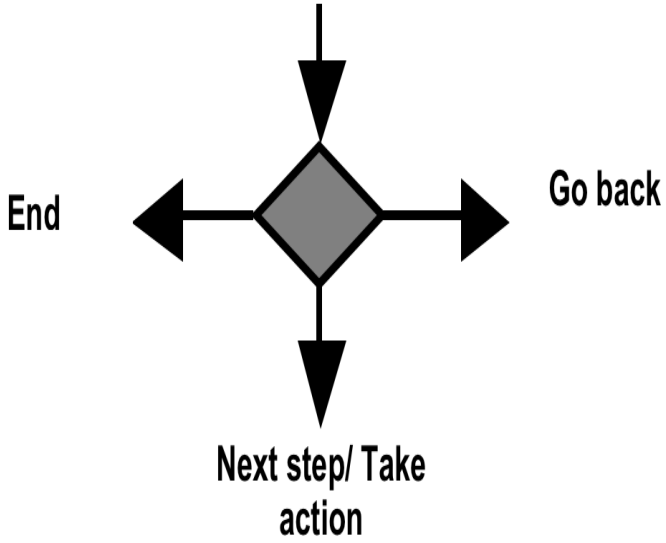
- Principles: risk-based (ISO), high-level screening of CC risks, focus on practicality, simplicity, self-learning

- Contents:
  - Summary
  - Introduction
  - Climate trends and projections
  - Risk assessment and risk treatment process
  - Conclusions
  - Annexes: Full projections, Terms, Workbook

The Risk Management Framework (ISO 31000)



Decisions to be Made at the Completion of Each Step



Step 1 in the Risk Management Process

- Be clear about objectives of the project, the results required, the project team, resources and the timelines
- Assemble the project team, assign responsibilities, and resources
- Define the timeframe, CC impacts and the vulnerabilities
- Begin to identify the stakeholders and consider the consultative process and information needs

Step 2 in the Risk Management Process

- Develop the potential sequence of risk events and also identify potential opportunities
- Preliminary screening of risk events, who or what could be affected and discard less serious
- Collect data and establish risk baselines
- Consider stakeholders and how they could be consulted
- Archive all data so that decisions can easily be revisited
- Tables and templates for recording and displaying data for each step (later)

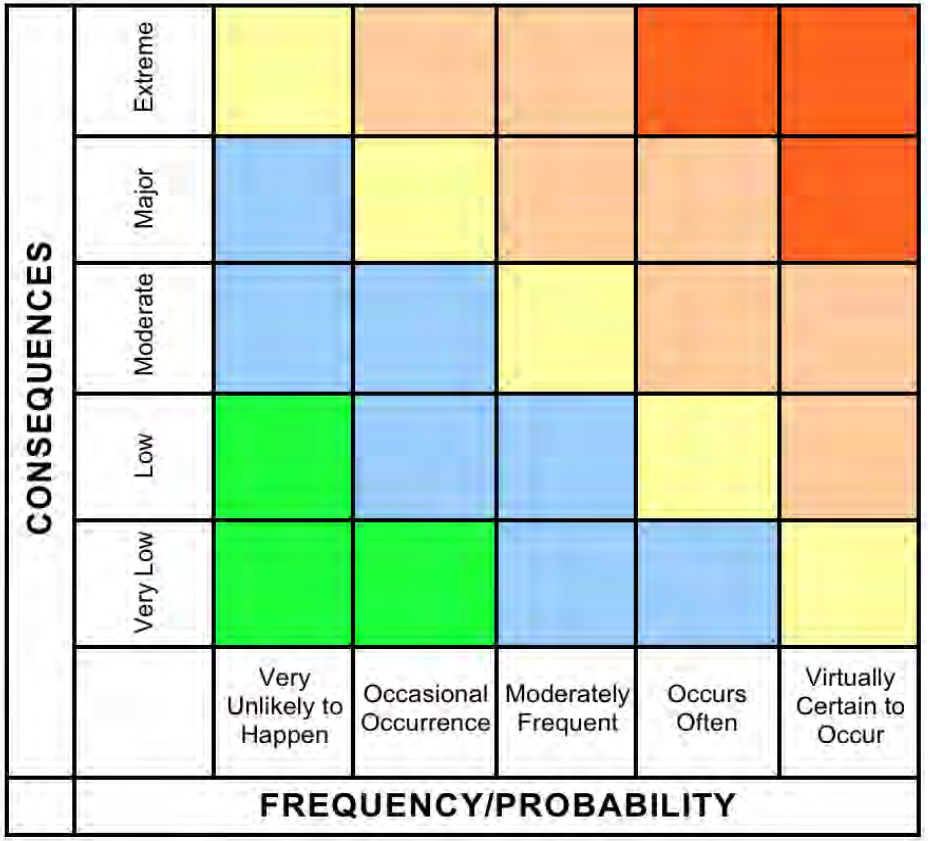
Step 3 in the Risk Management Process

- Decide how to estimate the likelihood and consequences of events
- Estimate the likelihood of the possible outcomes
- Estimate the consequences or potential results of the possible outcomes. Also consider the benefits of potential opportunities
- Assess stakeholders' perceptions of risks

Step 4 in the Risk Management Process

- Estimate the overall level of the risk for each event
- Compare the risks
- Consider the costs and possible benefits of both risks and opportunities
- Consider stakeholders and assess their acceptance of risk

Risk Evaluation Matrix: Comparison of Levels of Risk



	Extreme Risk: Immediate controls required
	High Risk: High priority control measures required
	Moderate Risk: Some controls required to reduce risks to lower levels
	Low Risk: Controls likely not required
	Negligible Risk: Risk events do not require further consideration

- Step 5: identify risk controls or adaptation measures and opportunities or benefits and analyze them for costs and benefits

- Step 6: develop the implementation plans and monitoring and measuring systems

Guide Annexes

- Annex A: Climate Change Trends and Projections
- Annex B: Glossary of Terms and Definitions
- Workbook: (all tables and templates needed to complete risk assessment and treatment process)

Conclusions

- Process is very powerful, yet extremely simple
- Initial perception of users is that is is very difficult: one simple example demonstrates its utility (later)
- The process should be reviewed periodically and repeated when important new data is available
- Process is sensitive to stakeholder views and perceptions
- Careful archiving of of all data, discussions, decisions and actions for later retrieval

The Climate Change Risk Assessment Process

- ✓ Participation
- ✓ Perspective
- ✓ Prioritization
- ✓ Presentation

Templates

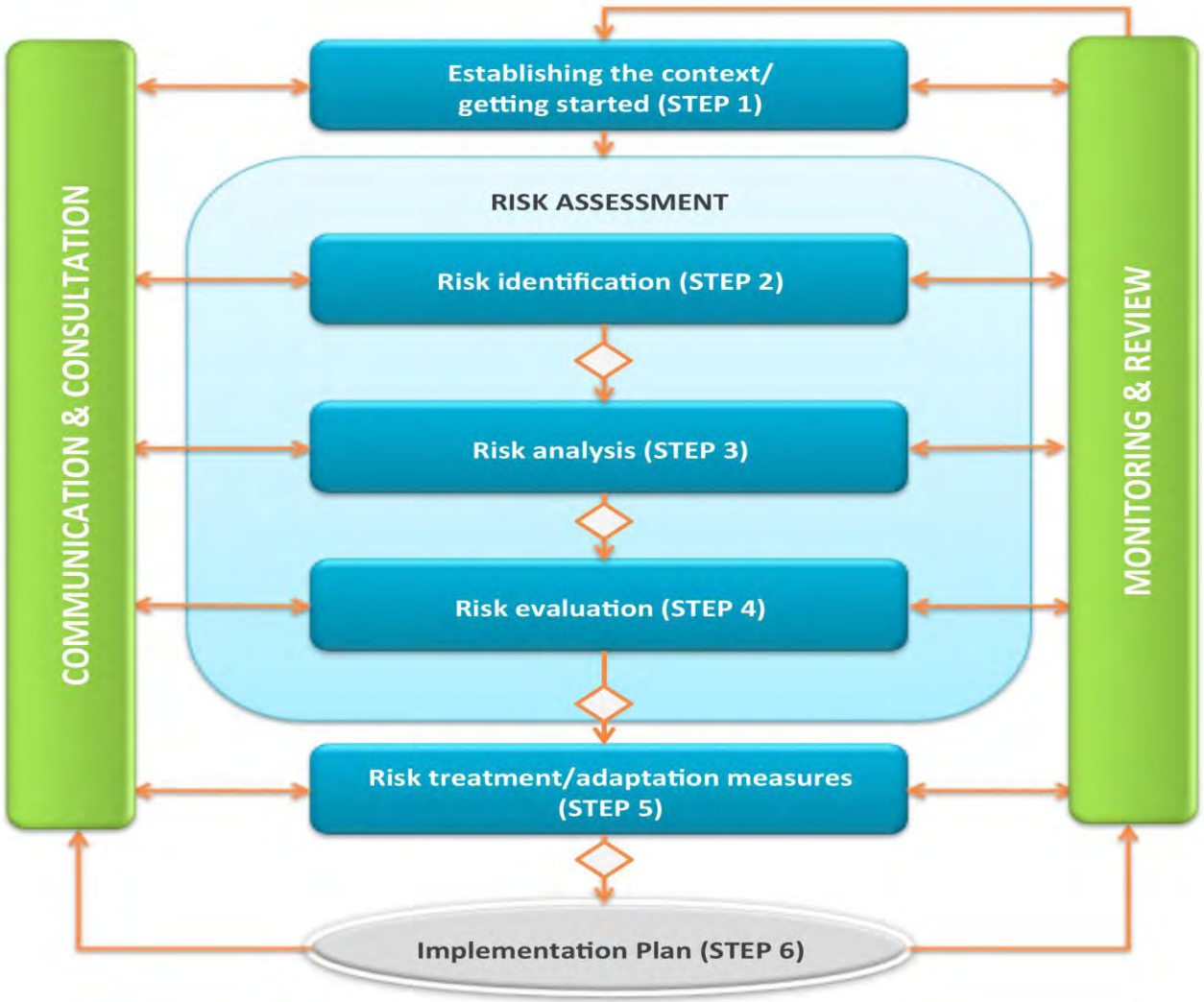
CLIMATE PROJECTIONS

CLIMATE IMPACTS (“Risk Source” per ISO 31000)
(Steps 1 & 2)

RISK EVENTS (Steps 3 & 4)

CONTROL/ADAPTATION MEASURES (Steps 5 & 6)

The Risk Management Framework (ISO 31000)



Step 1 – Establishing the Context/Getting Started

- Objectives
- Timelines
- Resources
- Stakeholders
- Communications
- Documentation

Step 2 – Risk Identification

Climate Impacts For Southern Saskatchewan

- Temperature
- Precipitation
- River Flow
- Wind

Temperature

General warming trend across the province, increasing between 2 – 4 degrees annually by 2050

Precipitation

- Generally limited changes in amount
- More precipitation in the winter and spring
- Less precipitation in the summer and fall
- Increase in rain to snow ratio (up to 10%)
- Increase in extreme precipitation events (5-10%)

Riverflow

- Earlier peak spring flows
- Earlier spring breakups
- Less summer flow
- More flash floods in small watersheds

Wind

An increase in intense winter storms (8 – 15%)

Impacts From Abroad

- Increase demand for crops
- Increase in domestic and foreign tourism
- Trans-border water issues
- Climate refugees?

Table 2: Preliminary Impact/Event Assessment (Step 2)

Impact Event	Comment	Likelihood			Consequences			Control Measures (existing or potential)
		L	M	H	L	M	H	

Note: Make rough estimates of likelihood and consequence (these will be expanded in Step 3)

Likelihood:

L Rarely Occurs
M Moderately Frequent Occurrence
H Almost Certain to Occur

Consequences:

Low
Moderate
High

Table 2: Preliminary Climate Change Impact/Event Assessment

Impact Event	**Comment**	**Likelihood**			**Consequences**			**Adaptation Measures (existing or potential)**
Temperature increases								
• Increase in frost free days and growing days (potential opportunity)				x		x		
• Heat waves	Health issues			x		x		
• Invasive species infestation			x			x		
Increase in extreme precipitation and wind events, including severe thunderstorms and tornadoes	Damage to communication and electricity lines personal injuries Increased demands on emergency response							
• F2 or greater tornadoes	Debris management			x			x	
• Extreme wind events	Wind damage to infrastructure			x			x	
• Non-winter severe precipitation events				x			x	

Step 3 – Risk Analysis

Risk is a representation of likelihood and consequences

Table 3.1: Estimates of Likelihood of Risks (Step 3)

Probability Range Type of Event	Very Low	Low	Moderate	High	Very High
Significant Single Event; or	Not likely to occur in period	May occur once between 30 and 50 years	May occur once between 10 and 30 years	Likely to occur at least once a decade	Likely to occur once or more annually
On-going / Cumulative Occurrence	Not likely to become critical/ beneficial in period	May become critical/ beneficial in 30-50 years	Likely to become critical/ beneficial in 10-30 years	Likely to become critical/ beneficial in a decade	Will become critical/ beneficial within several years

Table 3.1: Estimates of Likelihood of Risks (Step 3)

Probability Range / Type of Event	Very Low	Low	Moderate	High	Very High
Significant Single Event; or	Not likely to occur in period	May occur once between 30 and 50 years	May occur once between 10 and 30 years	Likely to occur at least once a decade	Likely to occur once or more annually
Drought (multi-year)				X	
Extreme wind events				X	
F2 or Greater Tornadoes			X		
Non-winter severe precipitation events			X		
Increased snow events inside snow belt				X	
On-going / Cumulative Occurrence	Not likely to become critical/ beneficial in period	May become critical/ beneficial in 30-50 years	Likely to become critical/ beneficial in 10-30 years	Likely to become critical/ beneficial in a decade	Will become critical/ beneficial within several years
Heat Waves					X
Invasive species infestation			X		
Increase In infectious diseases			X		
Increase in freeze/thaw cycle				X	

Consequence Risk Factors

- Health and safety
- Displacement
- Loss of livelihood
- Reputation
- Infrastructure damage
- Financial impact on local authorities
- Financial impact on stakeholders
- Water
- Air
- Land
- Ecosystems

Table 3.2: Estimates of Consequences of Risks (Step 3)
(Use one table for each risk event)

Factor / Degree	People				Economic			Environment			
	Health & Safety	Displacement	Loss of Livelihood	Reputation	Infrastructure Damage	Financial Impact on Municipality	Financial Impact on Stakeholders	Air	Water	Land	Ecosystems
Very Low											
Low											
Moderate											
High											
Very High											

EVENT: Heat wave

Factor / Degree	People				Economic			Environment			
	Health & Safety	Displacement	Loss of Livelihood	Reputation	Infrastructure Damage	Financial Impact on Municipality	Financial Impact on Stakeholders	Air	Water	Land	Ecosystems
Very Low		x	x								
Low					x	x			x	x	
Moderate				x			x				
High	x							x			x
Very High											

Final consequence rating: Moderate

EVENT: Invasive species infestation

Factor / Degree	People				Economic			Environment			
	Health & Safety	Displacement	Loss of Livelihood	Reputation	Infrastructure Damage	Financial Impact on Municipality	Financial Impact on Stakeholders	Air	Water	Land	Ecosystems
Very Low		x	x								
Low				x	x			x	x	x	
Moderate	x					x	x				
High											x
Very High											

Final consequence rating: Low

EVENT: Drought (multi-year)

Factor / Degree	People				Economic			Environment			
	Health & Safety	Displacement	Loss of Livelihood	Reputation	Infrastructure Damage	Financial Impact on Municipality	Financial Impact on Stakeholders	Air	Water	Land	Ecosystems
Very Low				x							
Low		x			x			x			
Moderate	x		x			x					x
High							x		x	x	
Very High											

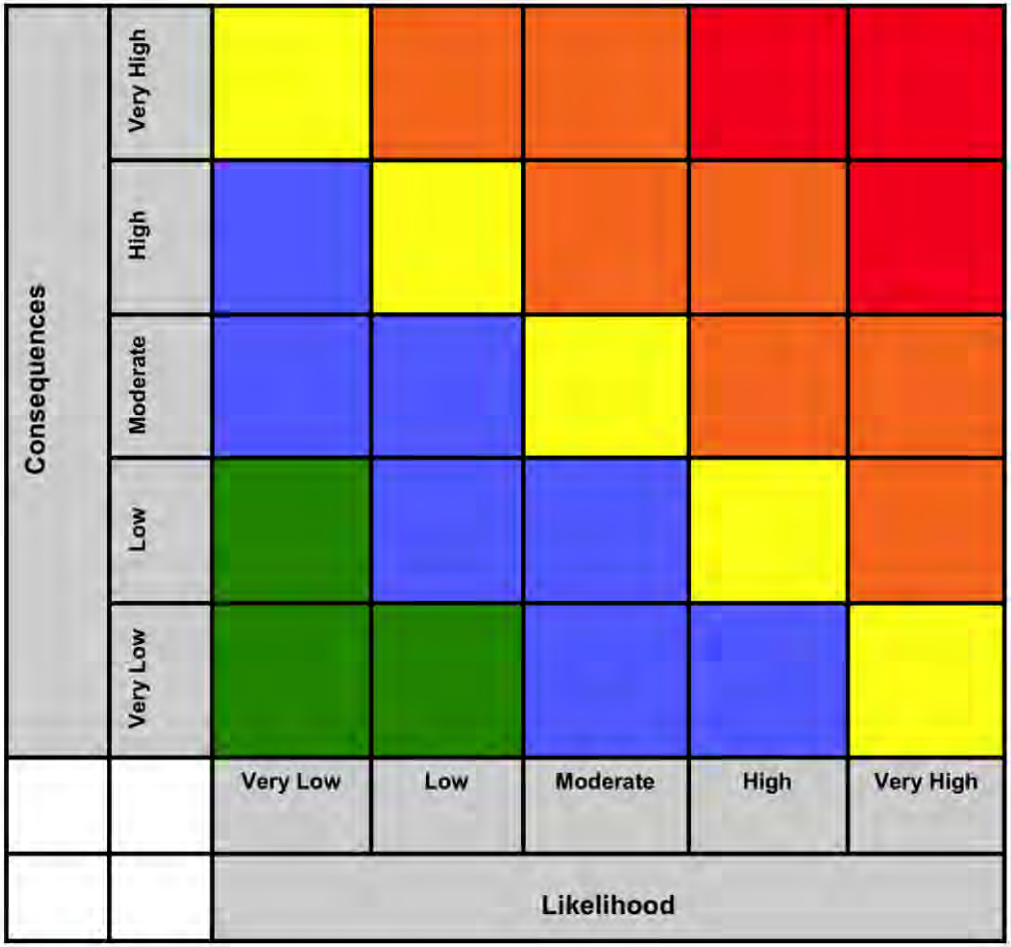
Final consequence rating: Moderate

TABLE 3.3: Suggested display for stakeholders and risk perception (Step 3)

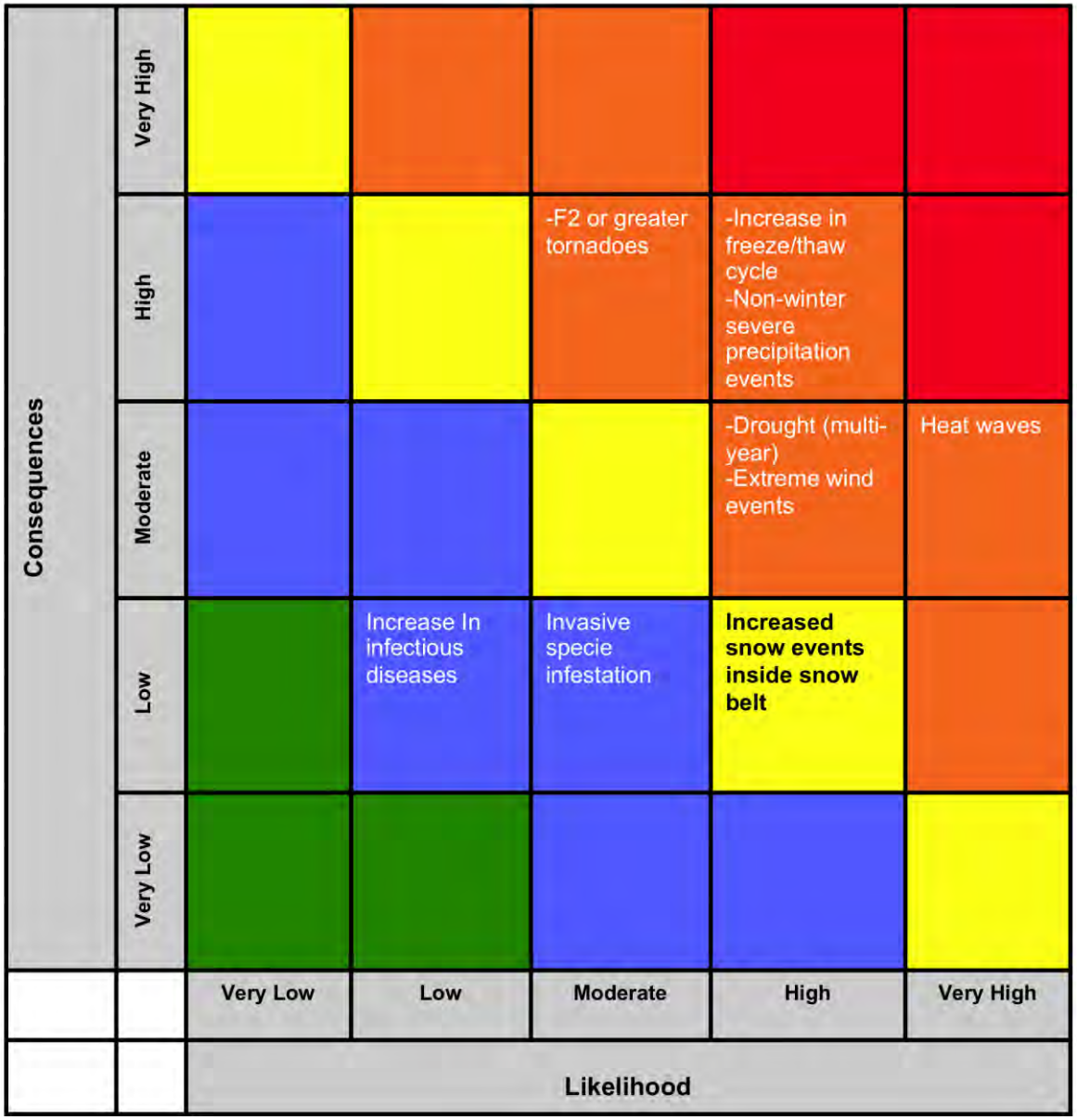
Climate Impact	Event	Stakeholders and Perception of Risk

Step 4 – Risk Evaluation

Figure 4: Risk Evaluation Matrix (Step 4)



STEP 4: RISK EVALUATION MATRIX



Step 5 – Risk Treatment/Adaptation

Table 5.1: Adaptation Treatment and Adaptation Measures (Step 5)

Risk Event	Adaptation Measure or Risk Treatment (Use as many rows as needed for each event)	Time Frame	Cost	Effectiveness	Acceptability	Comment / Evaluation

Time Frame	Cost	Effectiveness	Acceptability
Short – can be implemented within 10 years	**$** - can be completed within existing or planned budget allocation	**Low** – will have minor effect on risk event	**Low** – significant public/corporate/stakeholder resistance
Medium – can be implemented within 10-20 years	**$$** - will require additional funding	**Moderate** – will have moderate effect on risk event	**Moderate** – moderate public/corporate/stakeholder resistance
Long – can be implemented within 20 – 50 years	**$$$** - will require major additional funding/major capital program	**High** – will virtually overcome risk event	**High** – little or no public/corporate/stakeholder resistance

STEP 5: RISK TREATMENT AND ADAPTATION MEASURES

Risk Event	Adaptation Measure or Risk Treatment (Use as many rows as needed for each event)	Time Frame	Cost	Effective-ness	Accept-ability	Comment / Evaluation
Non-winter severe precipitation events	Define existing flood plain risk	S	$$	M	L	Necessary first step Key to future development Provincial resp?
	Mandate sewer back-up valves - existing structures - new structures	 M S	 $ $	 M M	 M H	Graduated approach Subsidized
	Update drainage maintenance program					
	Increase monitoring of water quality following severe rainfall					
	Update of urban drainage design					
	Implement storm water management practices					
	Educate the Public					

Step 6 – Implementation

Moderate Risks						
Summer electricity peak demand increases demands on the total electricity system	Energy efficiency program support to reduce peak demand					Move to Low Risk
	Increase renewable electricity supply supplemented by development of a Smart Grid solution					Demand response program support to shed load when needed
	Increase energy use performance requirements through codes and standards					
Public safety issues with infrastructure failure due to extreme weather events						
	Encourage the improved robustness of transmission and distribution infrastructure, including regular inspection and maintenance	S	$$$	M	L	Requires political will
Effects on aging infrastructure exacerbated by extreme weather events	Encourage the improved robustness of transmission and distribution infrastructure, including regular inspection and maintenance	S	$$$	M	L	Requires political will
Reduced water supply to cool thermal power plants	Regulate the replacement of water cooling systems with alternative technologies (ERCB & AENV)	S	$$	M	L	Dry cooling (evaporation) Hybrid wet-dry cooling More costly (condenser and cooling tower)
	Control allocation and consumption of water through pricing	M	$$	L	L	Use degraded or reclaimed water for power plant cooling
Reduced winter drilling season affects oil and gas exploration	Extend tenure time to meet requirements to accommodate shortened winter exploration season	S	$	L	M	

Comments?

Questions?

APPENDIX F: PARTICIPANT GUIDE AND WORKBOOK

ADAPTING TO CLIMATE CHANGE

A Guide for Municipalities

2012

Adapting to Climate Change: A Guide for Municipalities

Table of Contents:

Summary

Adapting to climate change may be one of the greatest challenges facing northern communities during the next century. This Guide has been written to assist municipalities particularly small and medium sized ones, understand the risks and opportunities of climate impacts and how to manage them. Although focussed at a municipal user, the Guide can be and is being successfully used by other levels of governments and other organizations.

The Planning Context

Most municipalities produce an annual business plan and a Hazard Identification and Risk Assessment. Many will also have a longer-term strategic plan, a business continuity plan and, possibly, an environmental management plan. It is likely that none of these address the long-term risks and opportunities that might arise from climate change impacts over the next 20 to 40 years..

The climate change risk assessment and risk treatment process outlined in this Guide has a 40 year horizon and is intended to provide inputs to the shorter-term municipal, strategic, business, HIRA and other plans.

Climate Change Data

The climate is changing in all parts of Canada. It is shown in Annex 1 that the trends observed for the past 40 years, in temperature and closely related factors are reasonably good indicators of the trends to be expected for the next 4 decades, i.e. to 2050. The extension of these trends also agrees well with Atmosphere-Ocean Global Climate Model (GCM) projections to 2050, using the A2 scenario of emissions from IPCC. A2 and A1F1 are the scenarios with highest rates of growth, consistent with experience since 2000, and with projections by the International Energy Agency.

The Tables for _____, given in Annex 1, provide information for a number of climate related factors , on the published trends to 2007 or 2008, and projections to 2050. Projections are based on a combination of GCM projections and extension of the observed trend lines. These results are generally consistent with those used in *From Impacts to Adaptation: Canada in a Changing Climate*, Govt. of Canada, NRCan, 2008.

This kind of straight-forward presentation of climate data past, and futures estimates, has been found to be readily understood and useful to many communities across Canada, in considering their needs for adaptation. For those wishing to pursue further, the climate and adaptation sciences, an extensive bibliography is provided in Annex 1 with special attention to _____.

Risk Management Process

Risk management is a process for selecting the best course of action in uncertain situations involving risk. It does this by helping to identify, understand, analyze and treat risks and to communicate to others about them. The Guide follows the framework for risk management described in the International Organization for Standardization's document *ISO 31000 Risk management – Principles and guidelines*, First edition, November 15, 2009.

The process described in ISO 31000 is shown in the figure on the following page. For ease of reference the individual steps have been numbered and a sixth step, the implementation plan, added.

This Guide is designed to address high level or strategic issues and opportunities over a broad range of climate impacts during a 40 - 50 year timeframe. However, the same process outlined here can also be used in a more detailed technical analysis of a specific issue or event or in shorter timeframe reviews.[1]

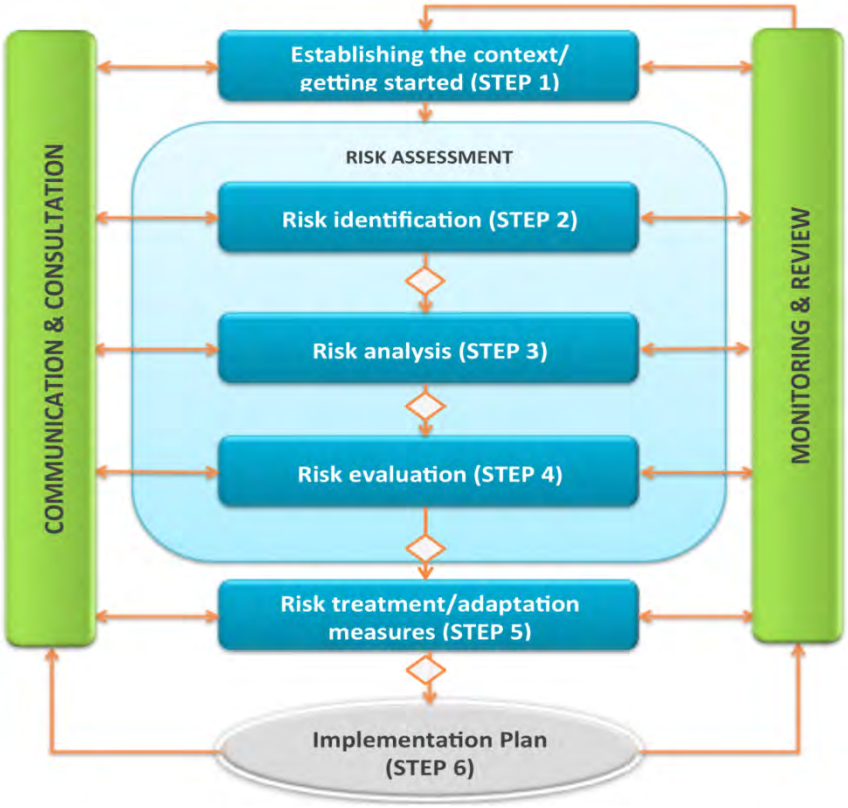
The process for analyzing the risks presented by a changing climate is a series of steps each followed by a decision point to:

1. End the process if no significant risk issue is found, or
2. Repeat the step if additional information is found or needed or a consensus on the findings is not reached by the participants in the process, or
3. Move on to the next step in the process.

The steps in the process and key actions to be taken are summarized in the diagram on the following page.

[1] The method used in this Guide has been made as simple as possible to allow non-technical users in small and medium size municipalities to undertake a study of expected climate impacts on their community and the potential risk events arising from those without having to hire consultants or other technical assistance. For communities that wish to explore other techniques ISO 31010 describes other risk assessment processes and other organizations such as Engineers Canada are developing more technical approaches as described at info@pievc.ca.

RISK MANAGEMENT PROCESS (ISO31000)



Establishing the Context or Getting Started: Step 1

If the process is to be undertaken by a group or team, the membership and responsibilities will be established, the terms of reference decided, the important stakeholders identified and an initial work plan drafted.

Risk Assessment: Steps 2, 3 and 4

Risk Identification: Step 2: Climate change impacts are analyzed and risk events and opportunities created by these impacts are identified. A preliminary estimation of likelihood and consequence is done to make an initial estimation of the level of risk. Some lower level risk events will be discarded at this stage and not considered further.

Risk Analysis: Step 3: A more detailed estimate is made of the likelihood and consequences of the risk events and opportunities brought forward from Step 2. The analysis will also consider a perceptions of those people or groups affected by this process.

Risk Evaluation: Step 4: The risk levels estimated for the events at Step 3 are compared and considered as to the acceptability of the risks from the team's and from stakeholders' perspectives. Low level risks are again discarded and the remaining risks are ranked and preliminary consideration is given to potential risk controls or adaptation measures.

Risk Treatment or Adaptation Measures: Step 5

For those risks assessed as unacceptable in Step 4:

- Adaptation measures or risk control strategies are identified to reduce risks to acceptable levels.
- The effectiveness of the adaptation measures are evaluated including their costs, and benefits.
- Optimal adaptation measures are selected and the acceptability of residual risks is considered.

For the opportunities that have been brought forward during the process consideration is given how these could be optimized or improved.

Implementation Plan: Step 6

While strictly not part of the ISO31000 process consideration is given to how the adaptation measures could be implemented and how the opportunities could be exploited and these should be monitored. Again the affect on stakeholders and their perceptions about the implementation plan should be considered.

In municipal studies the end objective may not be a full implementation plan but an intermediate step such as a briefing for Council or an examination of which risk reduction or adaptation measures would be coordinated with other municipal projects or programs. In any case, step five leads naturally to conclusions about what needs to be done in the long-term to reduce the municipality's exposure to climate impacts and the timeframe in which those actions need to be taken.

Other Considerations

General: This Guide suggests using readily available qualitative data for assessing the likelihood and consequences of risks and a small risk management or project team for the strategic assessment of risks. This will help the team explore the issues and possible outcomes rapidly and inexpensively.

Documentation: It is important to carefully document and archive, in readily retrievable form, the key information used, minutes of meetings and discussions, and decisions that were taken during the process. The results of the process, supported by good documentation, can be used to make a strong business case for taking action. The documentation archived during the process can also be used as a starting point for a more comprehensive risk management study if one is needed.

Communication and Consultations: Accurate, inclusive and timely dialogue with all participants and stakeholders on a continuing basis is vital throughout the whole risk management process. This is particularly important in a municipal setting when other communities, organizations or agencies may be affected or involved with the risk events or opportunities being considered.

Monitoring and Review: Risk management is an iterative process. The process should be repeated or reviewed periodically and whenever significant new information becomes available on climate change impacts, risk events or adaptation measures or opportunities. It is suggested that the municipality review and update the climate change risk assessment and adaptation plans every five years, or as mentioned, whenever significant new information becomes available.

The review and monitoring process should also consider the residual risks that were accepted in the initial planning process and whether that residual risk has altered or its acceptability changed.

Adaptation measures and opportunity exploitation plans should also be monitored continuously to ensure that the anticipated risk reductions or benefits are being achieved and whether plans should be modified or revisited.

Workbook

The Guide includes a separate Workbook that contains tables and templates that will assist in recording information and presenting the results in a clear and lucid manner.

The templates and tables and their headings are suggested formats only and users should replace any formats or headings with those they feel are more appropriate. The tables are also used for storing data about the risk events, stakeholders and adaptation measures.

Glossary of Terms and Definitions

The risk management process as defined by ISO31000 was developed from related processes used by the financial community, various professions such as engineering, medicine and geology among others, and numerous scientific disciplines. Some terms and phrases used here are unique to the risk management process and have different meanings or inferences in other contexts.

To avoid lengthy discussions about terminology a glossary of terms is included in this Guide that is derived from terms and definitions contained in ISO31000 and, where appropriate, some of that standard's national precursors. It is strongly recommended that users of this Guide employ the terms that are found in the glossary.

Foreword

This Guide has been specifically written to address the unique conditions in _____ and it emphasizes simplicity and common sense in its use.

Based on what is known about our changing climate, communities and governments need to proceed with urgency to examine their vulnerability. As outlined later in this Guide, there is convincing evidence that the climate has changed over the past forty years largely in response to rising concentrations of greenhouse gases in the atmosphere and that this change is accelerating.

Warming in most of Canada, including _____, has been greater than in most of the rest of the world and changes are projected to be as large or even larger and faster than in the recent past.

It is important to note that risk management is an iterative process and in this case, it is strongly recommended that municipal governments and others using this Guide repeat the process in about five years or sooner if important new information becomes available that would affect the study.

Although focussed at a municipal user, the Guide can be and is being successfully used by other levels of governments and other organizations.

1. Introduction

1.0. A sense of urgency

Global climate change is widely recognized as one of the world's greatest environmental, social and economic threats. In Canada, climate changes over the past 40 years are in part responsible for the exponential rise in economic losses from extreme weather events, premature weathering of infrastructure, stresses on water supplies, worsening air quality and related health and economic effects. Extreme events and rising temperatures are becoming more damaging as recent severe rainfalls, thawing permafrost and melting sea ice have demonstrated. At the same time, particularly for northern countries like Canada a warming climate presents certain opportunities and benefits.

Canada is more vulnerable than ever to the impacts of climate variability and change because of increasing urbanisation, a growing population and aging infrastructure. These changes put more people, property and ecosystems at risk. Efforts to manage and adapt to climate-related risks and opportunities have not kept pace with the challenges and it is virtually certain that the climate will continue to warm and become increasingly variable over the coming decades.

Municipal and regional governments have primary responsibility for or can significantly influence many of the factors that determine Canadians' vulnerabilities to climate-related risks and many are beginning to develop adaptive strategies.

But many are not. It is imperative that municipal governments get started now to:

- Better understand climate change impacts and their vulnerability to them,
- Identify the risks that are presented to their residents, infrastructure and the local environment and the opportunities as well,
- Analyze and prioritize the risks and determine the risk treatments and adaptation measures that should be applied to the most serious risks,
- Develop long-term adaptation plans and strategies for taking advantage of opportunities that can be integrated into their on-going planning, risk management and development processes, and
- Work with their neighbouring communities, industry and other organizations in the region to make best use of the time available before some of the more serious climate impacts are manifest.

This Guide has been developed to demonstrate that a proven process to undertake a risk assessment process and identify the best risk treatments and adaptation measures is simple and easy to do and requires few resources.

1.1 About the Guide

The Guide describes a risk-based approach that can be used to assist municipalities to adapt to climate change through long-term planning and short-and mid-term responses.

The Guide explains how to use the risk management process as described in the recently published International Organization for Standardization's ISO 31000, *Risk management – Principles and guidelines,* first edition, November 15, 2009. The Guide suggests a straight-forward approach that will get municipalities and other organizations started thinking and acting about adapting to our changing climate. A time-consuming, expensive or highly technical analysis is not needed to reach strategic decisions about climate adaptation, but may be needed in more detailed follow-up analyses of particular risk issues or events. Also see note 1 on page iii for further information about other approaches.

Chapter 2 and Annex 1 provide insights into what could be expected in the future climate in _____ and climate projection summaries that provide all the climate information users will require to undertake preliminary or high-level risk assessments and strategic adaptation planning for a timeframe 40 or 50 years into the future. As indicated earlier, these analyses will provide important inputs into municipalities' business and Enterprise Risk Management plans.

Chapter 3 explains the risk management process used in the Guide. It is based on ISO 31000 and some of the consistent practical implementation suggestions of the Canadian National Standard, *"Risk Management: Guidelines for Decision-makers"* (CAN/CSA-Q850-01). These standards also provide a glossary of definitions of risk management terms that are often confusing for users.

Chapter 3 also explains each step in the risk management process and includes:

- A description of the purpose of each step,
- An explanation of what to do and how to do it,
- A description of the expected output,
- A description of the decision to be made at the end of each step, and
- A checklist to ensure that all the important aspects of each step have been completed before moving on to the next step in the process.

The annexes of the Guide contain more detailed information about climate projections, a note about risk perception and communications to help orient the user to the very real problems of dealing with others about risks and, as noted above, a glossary of risk management terms.

The Workbook contains all the suggested tables and templates used in this risk management process and examples and case studies to illustrate for users how others have dealt with some common risk situations facing _____ communities.

1.2 Why risk management?

The impacts of a changing and more variable climate involve almost every aspect of society and create risks to the social, economic, cultural and environmental fabric of communities. They can also present opportunities that could benefit the community.

Projections of future climate and other important variables are somewhat uncertain, and there may be numerous adaptation options from which the optimal are to be selected. Adaptation decisions are generally evaluated as better or worse, not right or wrong.

Adaptation to climate change is characterized by uncertainty, complexity and risk. It can involve multiple decision-makers and other stakeholders with conflicting values and competing interests.

For every climate impact there is a range of possible responses in time, complexity and cost. For example, to deal with increasingly frequent and severe extreme weather events, short term responses might range from better warnings to increased maintenance of water management infrastructure or reduction of storage levels in reservoirs. Longer-term responses might include upgrading water management systems and better communications equipment. Multi-jurisdictional responses could involve the re-routing major transportation arteries and changes to building codes among others. The risk management process will help identify the best solutions and a range of possible responses.

Risk management offers a practical and credible approach in the face of uncertainties for prioritizing complex risk issues and for selecting optimal risk reduction strategies in order to achieve acceptable levels of remaining societal risk. It also provides a means for balancing a range of considerations, for using predictive information and for dealing with uncertainties.

The process can be also be used to provide a more technical approach to a detailed or complex risk issue. At the same time, it can be used to identify opportunities that could be exploited.

This Guide makes use of ISO standards and techniques and tailors them for _____ communities. Managing risks is inherent in the job responsibility of most municipal managers. The process outlined here is a simple way of developing a strategic overview of risks and opportunities, of determining who is likely to be affected or be involved and adaptive measures that can reduce risks to acceptable levels.

2. Climate Trends and Projections for _____.

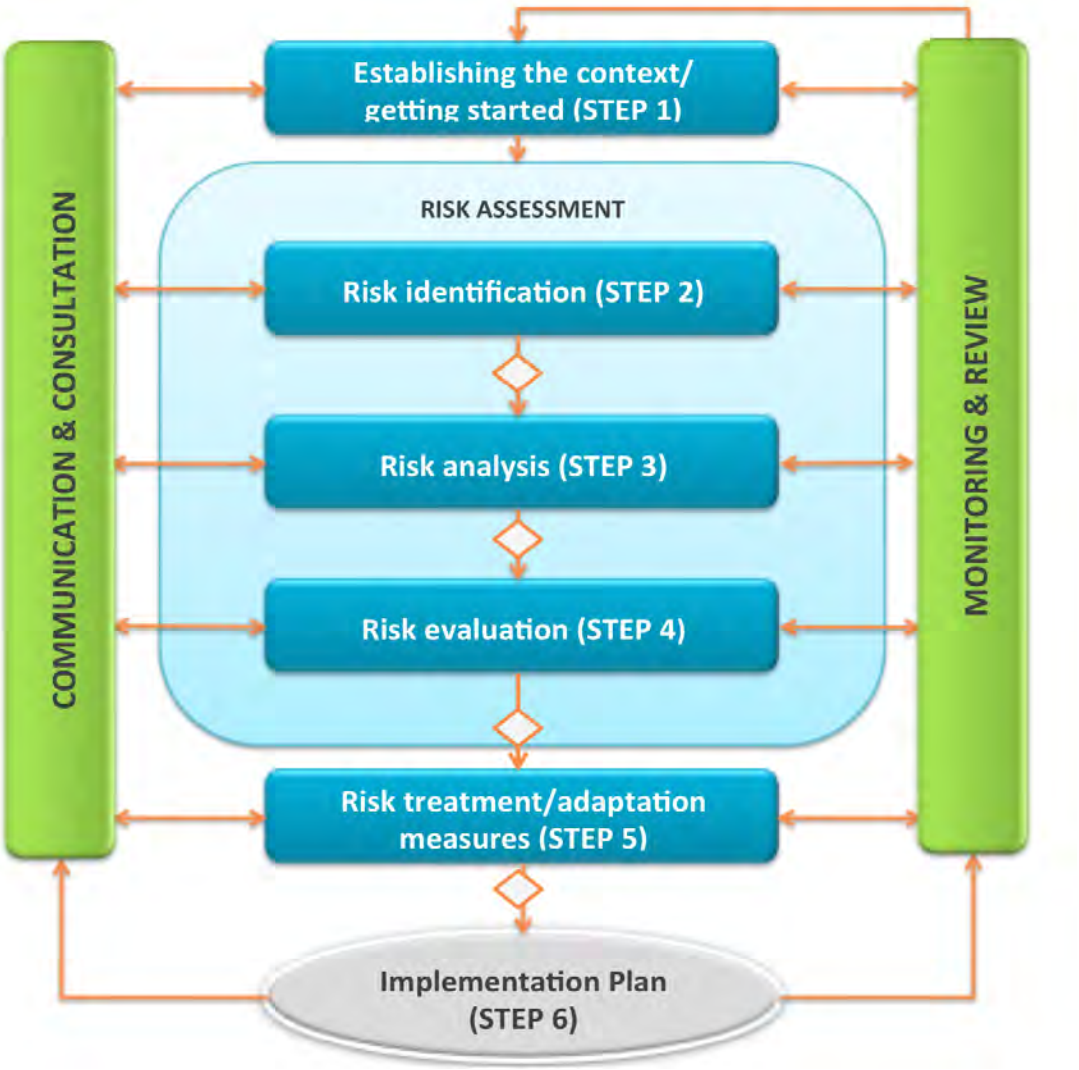
3. *The Risk Management Assessment and Risk Treatment Process*

3.0 Overview of the risk management process

Risk management is a systematic process for selecting the best course of action in uncertain situations. It provides a framework for developing strategies to respond to potential climate changes that create or increase risk.

The framework in this Guide is based on the International Organization for Standardization's ISO 31000, *Risk management – Principles and guidelines,* first edition, November 15, 2009-and includes some practical process features from the Canadian national standard *"Risk Management: Guidelines for Decision-makers"* (CAN/CSA-Q850). The process, shown below in Figure 1, consists of five steps and a sixth step, the development of an implementation plan.

Figure 1: RISK MANAGEMENT PROCESS (ISO31000)

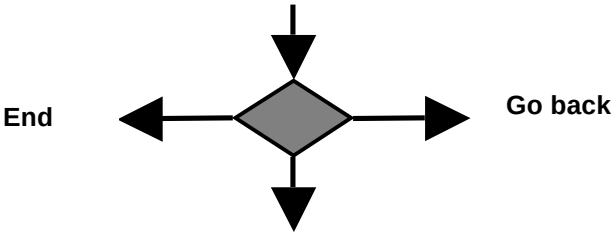


This illustrates the sequence of the key activities of identifying, estimating, evaluating and ranking risks and opportunities then determining options to lower risks to acceptable levels or exploit opportunities. The details of what is done in each step is outlined in the following sections; a checklist helps users confirm their actions and examples in Workbook illustrate the process.

A very important part of the process is a continuous dialogue with those involved and affected by the issue. Risk situations can be interpreted differently by various groups of people, resulting in quite different perceptions of risk, therefore the risk management process emphasizes the importance of how events might affect or be perceived by different groups.

In the risk management process, each step leads logically to the next, unless the risk issue is resolved, in which case the process is ended. Each step can be repeated to include new information or new analyses as these become available. At the completion of each step there is a decision to be made as shown in the "Decision Diamond" in Figure 2.

Figure 2: Decision diamond – decision options at completion of each step



This Guide focuses on using readily available data and a relatively small risk management group or project team. This will help the team explore the issues and possible outcomes rapidly using qualitative[2] data for the most part. The results, supported by good documentation can be used to make a strong business case for taking action.

The process outlined in this guide is an overview or simplified examination of the risk or risks that face the municipality and will help define the issues and provide some readily useable results.

[2] Also see ISO 31010 for other methods of assessing likelihood and consequences. The matrix method used here is among the simplest for the purposes used in this Guide

The outcomes of the initial process may point to the need to do a more comprehensive analysis of all or some of the issues identified, using more detailed quantitative data or more in-depth expertise with which this guide can also assist.

Guiding principles.
The risk management process is built upon several important principles:

- **Identifying and engaging important affected or involved groups**
  These groups and individuals should be identified and involved during the entire process. The project team may be modified to include members of these groups if it will help deal with the particular issue being addressed.
- **Communication**
  The project team should develop an open and trustful dialogue that continues throughout the process, with groups and individuals who may be affected or involved with the risk.
- **Documentation**
  Records should be thoroughly and carefully taken of important meetings, information sources, and all activities stored in a "risk information library" so that it can easily be retrieved in the future. This will help to:
  - Review how risk rankings and risk control options were derived,
  - Provide baseline information for future iterations of the process,
  - Promote accountability and transparency
- **Use of existing tools, human and technical resources**
  The project team should make maximum use of existing resources, such as data, local knowledge and technical expertise, and previously documented experiences.
- **Education and Awareness**
  Municipal staffs should have a good knowledge level and awareness about climate change impacts and adaptation measures so that they can successfully complete the risk management process. When adaptation measures or opportunities are implemented, there may be a need to provide some education and awareness for stakeholders and possibly the general public to get their support.

3.1 Establishing the context/getting started (Step1):

Purpose

The climate change risk assessment and management process starts with this step and includes the following preparatory activities;

- Understanding the climate change projections for the areas of interest and the associated vulnerabilities.
- Ensuring clarity about the objectives of, timeframe and resources available for the risk and opportunity assessment.
- Identification of who will be members of the project team and principal people or groups that may be affected or involved;
- Assignment of responsibilities to the various members of the project team and determination of the time and resources needed to complete the study; and
- Development of a work plan.

The team leader is usually a municipal planner or another senior member of the municipal staff.

The time required by the team to complete the process depends on the scope of the risk assessment, i.e. a study of a specific climate impact or a larger strategic study of all impacts. However, it is recommended that a relatively simple overview of the problem using readily available data, as explained in Steps 2 and 3, would be very useful in developing a better understanding of the issues and scope of the problem. To do this, the team would require only a day or several days to complete a strategic overview.

What to do and how to do it?

(1) Ensure the project team has access to and has read the latest versions of the principal literature that is applicable to municipal operations in _____.[3]

(2) Establish the project team and its terms of reference, and for a larger study, develop the work plan and the key milestones:

- Select team members with the necessary expertise to deal with the risk issues being considered.
- Ensure that there are representatives from the main municipal organizations that will be affected or responsible for implementing the adaptation measures. For a larger, more detailed study, some support staff may be needed to handle the administrative and documentation matters. Others, such as legal, technical or financial advisors may be involved at times or review or advise on certain aspects of the work.
- The team leader should ensure that members of the team have sufficient time committed to complete the project and are familiar with the risk management process.

(3) Ensure that the team is clear about the climate change issues to be investigated and any restrictions on the scope of the study.

(4) Assign project team responsibilities, allocate resources and set schedules.

(5) Identify and list the main municipal groups, outside organizations, people or groups that may be affected or involved in the study or the adaptation measures and begin an estimate which would:

- Identify any organizations, individuals or groups that can affect or may be affected by decisions or actions resulting from the risk management process. This group could be quite large.
- Consider their probable interests, concerns, rights and likely issues. Begin to think about how members might perceive various risk issues and how this might affect the decision process and communications with them.
- Recognize that this group may evolve throughout the process.

(6) Start the record keeping system that the group will use for the project:

- Records should be retained of all the information collected throughout the project, including information on the risks, data that are used to analyse the risks, a record of decisions taken, views of the people or groups that may be affected or involved, records of meetings and any

[3] The best place to start is the Natural Resources Canada website at: adaptation.nrcan.gc.ca/pub_e.php. Two important references for municipalities are: *From Impacts to Adaptation: Canada in a Changing Climate 2007,* and *Adapting to Climate Change : An Introduction for Canadian Municipalities, 2010.*

other information that may be obtained during the risk management process.
- These careful records will provide the means to trace the logic behind any decisions made. Also it will make it easy for the project team to review the process, should any additional information become available.

Expected results and outputs

- Project objectives, timelines and resources are agreed.
- Project team established.
- Terms of reference and budget for project team developed and approved.
- Principal people or groups that may be affected or involved have been identified and preliminary analysis of their needs, concerns and probable issues completed.
- Communications or dialogue with groups that may be affected has been considered.
- Collection of records and documentation begun.

Decision

There are three decision options (see the decision diamond in Figure 2 on page 5 End, Go back or Next step/Take action.

- **End** the process if the climate change impacts and risks are considered by the project team to be completely acceptable (very unlikely at this stage).
- **Repeat** the step if the project parameter are not clear, if the project team is not adequately established or if other important internal or external parameters are not settled.
- **Go to Step 2** If the situation continues to be a concern.

Checklist

Step 1: Establishing Context: Getting Started	
Have you:	
1	Ensured that the climate risk assessment project objectives, are clear and manageable, time frames and resources are appropriate?
2	Established a project team, project workplan and team members' responsibilities?
3	Identified the resources required to undertake the project, and any existing capacity that is available to the project team?
4	Identified the principal people or groups that may be affected or involved and begun to define their probable issues, needs and concerns?
5	Ensured a good understanding among team members of climate change predictions and vulnerabilities?
6	Started the records keeping system?

For examples of how others have done Step 1 see Step 1 in the case studies in the Workbook.

3.2 Risk identification (Step 2):

Purpose

This is the beginning of the risk assessment part of the process. The sequence of risk events leading from the climate change impacts and vulnerabilities are carefully developed and given a preliminary examination. The project team does this by:

- Identifying of the specific climate change impacts and the associated potential risk events to people, property or the environment and the possible opportunities.
- Conducting a preliminary analysis of these risk events to determine in a very general sense their likelihood and possible consequences.
- Considering which events present a minimal level of risk and can be discarded from further consideration.

What to do and how to do it?

(1) Do a careful analysis of the climate impacts to identify the risk events and potential opportunities that may result over the time frame being considered[4].

(2) Based on the knowledge of the project team and other readily available information[5], make a rough estimate of the likelihood that a particular risk event will occur and the level of severity of the possible consequences on a three level scale. Table 2 below is a suggested format for tabulating the preliminary level of risk from the sequence of risk events. Use the same logic for any opportunities the project team has identified.

[4] For example, a climate impact might be "intense rainfall" and in consequence "increase storm water/peak flows". The latter is the "risk event" that the municipality has to consider and eventually develop an adaptation measure that will reduce or better manage storm water peak flows. Similarly, climate change may present some opportunities for municipalities. These should be noted in list form and the project team may wish to consider means to facilitate them in the future. Because the main focus of this Guide is to analyze the risks, no specific tables or forms are being suggested for opportunities.

[5] For example for a start from municipal records, the weather records for the region, emergency measures organizations, fire records, Public Safety Canada.

(3) The risk events will form the basis for more detailed risk estimations and evaluations in the next step.

Impact Event	**Comment**	**Likelihood**			**Consequences**			**Risk Treatment/Adaptation Measures (existing or potential)**
		L	**M**	**H**	**L**	**M**	**H**	

Table 2: Preliminary Climate Change Impact/Event Assessment (Step 2)

Note: Make rough estimates of likelihood and consequence (these will be expanded in Step 3 to include a consideration of specific societal, economic and environmental consequences).

Likelihood:

L Rarely occurs
M Moderately frequent occurrence
H Almost certain to occur

Consequences:

L Low
M Moderate
H High

(4) This preliminary estimation will act as a screening tool to reduce the number of risk events which will be carried forward to the next step and also be a test for the usefulness of available data and information needed to estimate likelihood and consequences. Discard from further consideration any risk events that appear to be negligible, very low or low level of risk. Keep track of potential opportunities in a similar fashion.

(5) Estimates of risk levels are made against the risk baselines (i.e. current risk levels). Use whatever data are available to establish risk level baselines (for example, flood plain maps for 20 year flood risk levels) including the opinion of recognized experts within the municipal staff or experts from other levels of government or other organizations:

- Review the existing information on current vulnerability and climate-related risks, based on previous studies and experiences and expert opinion.
- Identify and describe the risk controls currently in place to manage the specific climate-related impact being considered. Describe their effectiveness and any gaps. Examples of risk controls for a flood situation would be a warning system an evacuation plan, stockpiled sandbags etc.

(6) Continue the analysis of those other organizations, people or groups that could be affected by the risk events and update the list begun in Step 1:

- Now that there is more information on the potential risks, identify any additional stakeholders that should be involved.
- Refine the analysis of their needs, interests and concerns, especially other municipalities or organizations of the provincial government that should be or might be involved.
- Consider how these people of organizations could be engaged or informed.
- Create a database of these people or groups that includes their contact information and the results of your stakeholder analysis. Update the database throughout the process.

(7) If your project team thinks that you may need a risk communication plan for stakeholder engagement, start to outline what this would consist of and begin to implement a dialogue with key people and groups.

(8) Update the data and records storage system that you are using:

- Organize all the information collected in this step and keep it in a safe, dedicated space. This is where all the information, assumptions,

concerns, decisions and changes made throughout the process are kept.
- For example the information storage system at this step in the process could include:
  - Baseline data and information on the climate impacts or trends,
  - Complete descriptions of the climate impacts, risk events and opportunities, including the information used to make preliminary estimates of the risk levels or benefits ,
  - Information about the risk events that are not going to be considered further,
  - All stakeholder information, including minutes of meetings with them or other records of stakeholder communications,
  - A record of all decisions and assumptions,
  - Record the source of the information and the date it was collected, and any weaknesses or inaccuracies in the data.

Expected results and outputs

- Risk events and potential opportunities are developed and a preliminary analysis is completed for each, event showing initial estimates of potential consequences or benefits and likelihood.
- Existing control measures are identified as are preliminary thoughts about additional adaptation or control measures.
- Baseline information has been collected, or plans have been made to collect additional baseline information.
- Additional analysis of other municipal departments, government organizations, people or other groups who might be affected by the risks has been completed.
- An outline of a communications plan for these people or groups has been developed if it is needed.
- The data storage system is started and Important reference material is documented and stored.

Decision

There are three decision options (see the decision diamond in Figure 2 on page 5. End, Go back or Next step/Take action.

- **End** the process if the climate impacts and risk events are considered by stakeholders and the project team to be acceptable.
- **Go back** to Step 1 or the beginning of Step 2 if the project team considers that it is necessary to improve on any aspect of the information developed in those steps or to make any changes, if appropriate. Given the nature of the climate change issue, it is not unusual to have to improve data collection and revisit assumptions in order to enhance the credibility of the entire risk management process.
- If the risk situation continues to be a concern, proceed to the **Next Step.**

Checklist

Step 2: Risk Identification	
Have you:	
1	Developed climate impacts, risk events and opportunities and completed a preliminary analysis of their probabilities and consequences or benefits?
2	Discarded risk events that are negligible, low or very low risk levels?
3	Established a baseline of data for each of the risk scenarios?
4	Developed a stakeholder database?
5	Refined your stakeholder analysis?
6	Updated the data storage system?

For examples of how others have done Step 2 see Step 2 in the case studies in the Workbook.

3.3 Risk analysis (Step 3):

Purpose

In this step a more detailed consideration is given to the likelihood and consequences of the climate change risk events and opportunities that were selected in the previous step. One of the final things that was done in the previous step was to discard from further consideration risk events that were negligible, very low or low levels.

What to do and how to do it?

(1) Consider what methods the project team should use for estimating likelihood and consequences. Some options are:
- Historical records, including municipal, provincial, federal or community records and newspapers, to determine likelihood or consequences,
- Technical data and climate projections from climate projections in Annex 1. Information about climate impacts from IPCC reports[6] NRCan publications (see note 4 on page 6) or from other provincial, territorial, or federal government sources.
- Local experts or knowledgeable opinions, for example from university or college sources or local special interest groups.

(2) Estimate the likelihood of possible outcomes**.** A simple table such as Table 3.1 (shown on the next page) helps to record estimates and assists in putting significant single events or on-going or cumulative occurrences in the same likelihood context.
- For the simple analysis suggested in this guide, an easy four or five tier comparative rating system (such as a scale from "occurs very often" to "occurs almost never") is useful for assessing the relative likelihood of risk events.
- For climate change assessments, events should be estimated to a future date that stakeholders can relate to, for example 10 to30 years into the future for local governments, or for senior levels of government, 40 or 50 years or in some situations such as long-term infrastructure, as far as 100 years.
- For familiar events such as floods, fires or diseases, estimates can typically be derived from readily available historical data such as research reports, insurance company records or from similar risk situations in other regions or countries.
- If the team has the technical experience, the use of sensitivity-type analyses, technical projections, expert judgment or other practicable and credible methods to put some boundaries or estimate of uncertainty on the projection of the likelihood of the outcomes.

(3) Estimate the overall consequences of possible outcomes. Table 3.2 (on the next page) is a suggested way to record consequence levels for a variety of consequences from a single risk event.
- As with likelihood estimates, a simple comparative impact rating system (such as a four or five tier scale from "very minor effects" to "extremely serious effects") may be useful for making relative estimates of various consequences from a particular risk event. If extensive loss and other impact data are available, explicit values could be used in a tabular form so that the comparative severity can be compared. At this stage, definitive measures are not necessary as this is a ranking process to determine which risks are the most severe (see note 3 on page 5 for further information).
- Estimate the magnitude of each of the various risk events, should it actually occur. Use measurable, verifiable data wherever possible. Again, look for data and information in research reports, insurance company records or information from similar risk situations in other regions or countries.
- It may be helpful to consider the expected consequences under several sub-categories, for example, social, economic and environmental aspects. This may make comparing the losses or consequences easier and provide a baseline for later evaluation of risk control measures. Table 3-2 shows one way of displaying these. The headings in this table are generic and the project team should give some consideration to what factors are important to them.
- After each aspect of the risk consequences are considered, the project team should consider what the overall consequence is. This will be carried forward to Step 4

(4) Assess the perceptions of risk by those people or groups who might be affected. These perceptions of the importance or risk levels, are very important and may have a large influence on the ranking of risks.

> This is probably the most difficult and time consuming step. It is important that the project team reach a consensus about the levels of likelihood and consequences for each event in the risk scenario. If at the end of this step there is disagreement among team members, the step should be repeated or the disagreement flagged for review later.

[6] http://www.ipcc.ch/publications_and_data/publications_and_data.shtml

Table 3.1: Estimates of Likelihood of Risks (Step 3)

Probability Range Type of Event	Very Low	Low	Moderate	High	Very High
Significant Single Event; or	Not likely to occur in period	May occur once between 30 and 50 years	May occur once between 10 and 30 years	Likely to occur at least once a decade	Likely to occur once or more annually
On-going / Cumulative Occurrence	Not likely to become critical/ beneficial in period	May become critical/ beneficial in 30-50 years	Likely to become critical/ beneficial in 10-30 years	Likely to become critical/ beneficial in a decade	Will become critical/ beneficial within several years

Note: Use as many rows as needed to included the selected risk events.

Table 3.2: Estimates of Consequences of Risks (Step 3)
(Use one table for each risk event)

Factor / Degree	People				Economic			Environment			
	Health & Safety	Displacement	Loss of Livelihood	Reputation	Infrastructure Damage	Financial Impact on Municipality	Financial Impact on Stakeholders	Air	Water	Land	Ecosystems
Very Low											
Low											
Moderate											
High											
Very High											

Note: The project team should modify the columns to include the consequences that they consider important for example some may wish to include legal liability or differentiate between capital and operating costs .

Note: In both tables 3.1 and 3.2 the measurements are expressed in qualitative terms ("not likely to occur" to "likely to occur" and "very low" to "very high"). It is also possible to express these in numerical values so that adding or multiplying them gives a quantified relative likelihood or impact consequence. The problem with using numerical values is that the reader may think that it implies more accuracy than actually exists. The project team should consider the method to be used to compare relative likelihood and consequence values and agree on the most appropriate way of assigning relative values. (see also note 3 on page 5)

(6) Continue to update the stakeholder lists from Steps 1 and 2. The team may wish to consult with some key people in the municipality, other municipalities or groups that might be affected or concerned.

- If the project team considered it important in Step 2 to engage some of the stakeholders in a meaningful dialogue this should begin to be implemented now. Discussions could be held about the risk estimates and their issues and concerns. In a simple study this may be through conversations with a few representatives of the most important stakeholders
- Some people may not agree with the likelihood or consequence estimates. Record their different views. Later in the process, return to this step, if necessary, to test and discuss the sensitivities of the proposed adaptation measures to these different views of likelihood or consequences.
- Stakeholders' issues and concerns will probably change as they become more familiar with the risk scenarios and the risk management process. Document these changes on an ongoing basis.
- At this stage when stakeholder concerns may become more important, consider using a chart such as the one shown in Table 3.3 below to list the stakeholders and their attitudes about various risks.

TABLE 3.3 Suggested display for stakeholders and risk perception.

Risk Events	Stakeholders	Perception of Risk
	Use a many rows as needed	

(7) Update the archived information with all data from this step. Carefully document all sources used.

Expected results and outputs

- Estimates of likelihood and consequences of risk events and opportunities.
- Presentation of likelihood and consequence estimates in a format that is easy-to-understand by non-experts.
- Estimates of the acceptance by stakeholders of risk, or a record of reasons for non-acceptance, based on a dialogue with the stakeholders and a careful documentation of their perception of the risks.

Decision

There are three decision options (see the decision diamond in Figure 2 on page 5. End, Go back or Next step/Take action.

- **End** the process if the estimated level of risks are much lower than initially estimated in the preliminary analysis, and stakeholders agree that there is no longer a significant concern.
- **Go back** if:
  - The project team is unable to reach a consensus about the level of risk events,
  - There is new information that needs to be considered
  - Additional risk scenarios need to be considered,
  - There are doubts about data quality or analytical methods, or
  - Not all important stakeholders are comfortable with the level of uncertainty associated with the analysis.
- Proceed to the **next step** if the project team is comfortable with the data, assumptions and outcomes of the risk estimation process.

Checklist

Step 3: Risk analysis	
1	Are you satisfied with the quality of your data?
2	Have you analyzed and assigned appropriate levels of likelihood to each risk event and opportunity?
3	Have you considered the expected loss, other consequences or benefits from each risk event and opportunity?
4	Have you reached a consensus about the overall consequence for each risk event?
5	Are you comfortable that stakeholders' perceptions have been assessed for each of the risk scenarios

6	Has the process been carefully documented and the data storage system updated with all relevant information?

For examples of how others have done Step 3 <u>see Step 3 in the case studies in the Workbook.</u>

3.4 Risk evaluation (Step 4):

Purpose

In this step, the project team develops a process for comparing or ranking each risk event and opportunity. This is done by:

- Confirming the overall likelihood and consequence rating that was done after Tables 3.1 and 3.2 were completed in Step 3 including costs, benefits and acceptability. The overall rating should also consider the needs, issues and concerns of the principal stakeholders in the municipality, other organizations or outside groups that may be affected or involved.
- Identifying unacceptable risks and ranking them for risk reduction or control measures.
- Opportunities have also been rated in Step 3 in a more general way by their likelihood and potential benefits. These should be confirmed in Step 4 and the opportunities ranked in some order of importance for exploitation.

What to do and how to do it?

To this point in the process, only the impacts, risk events, and opportunities have been analyzed. Now the risks will be compared in terms of the values that were used in Step 3. Other factors may also be brought into consideration such as the costs and benefits of that might accrue.

(1) Compare the risks considering the likelihood and consequence analyses from Step 3. The team will have arrived at an overall consequence rating from the more detailed assessment of social, economic and environmental consequences. It is suggested that the team use a simple and convenient consequence scale ranging from very low to very high along with the likelihood estimates.

- Consider using a "risk evaluation matrix" as shown in Figure 4 on the next page to assist in comparing or prioritizing the various risks. The chart below in Figure 4 is an example for such a display. Combine the likelihood and consequence ratings for each risk as determined in Step 3 into a single value to be entered into the matrix. Establish acceptability values against which the various risks can be compared. This chart uses qualitative measures such as "very low", "low", "moderate", "high" and "very high". Other comparators such as numerical values may be used so long as they do not imply an unrealistic accuracy.
- Because experts and non-experts generally view risks differently, it is important to maintain an open and interactive dialogue with the principal people or groups that may be affected or involved in order to accurately gauge their level of acceptance of risks.

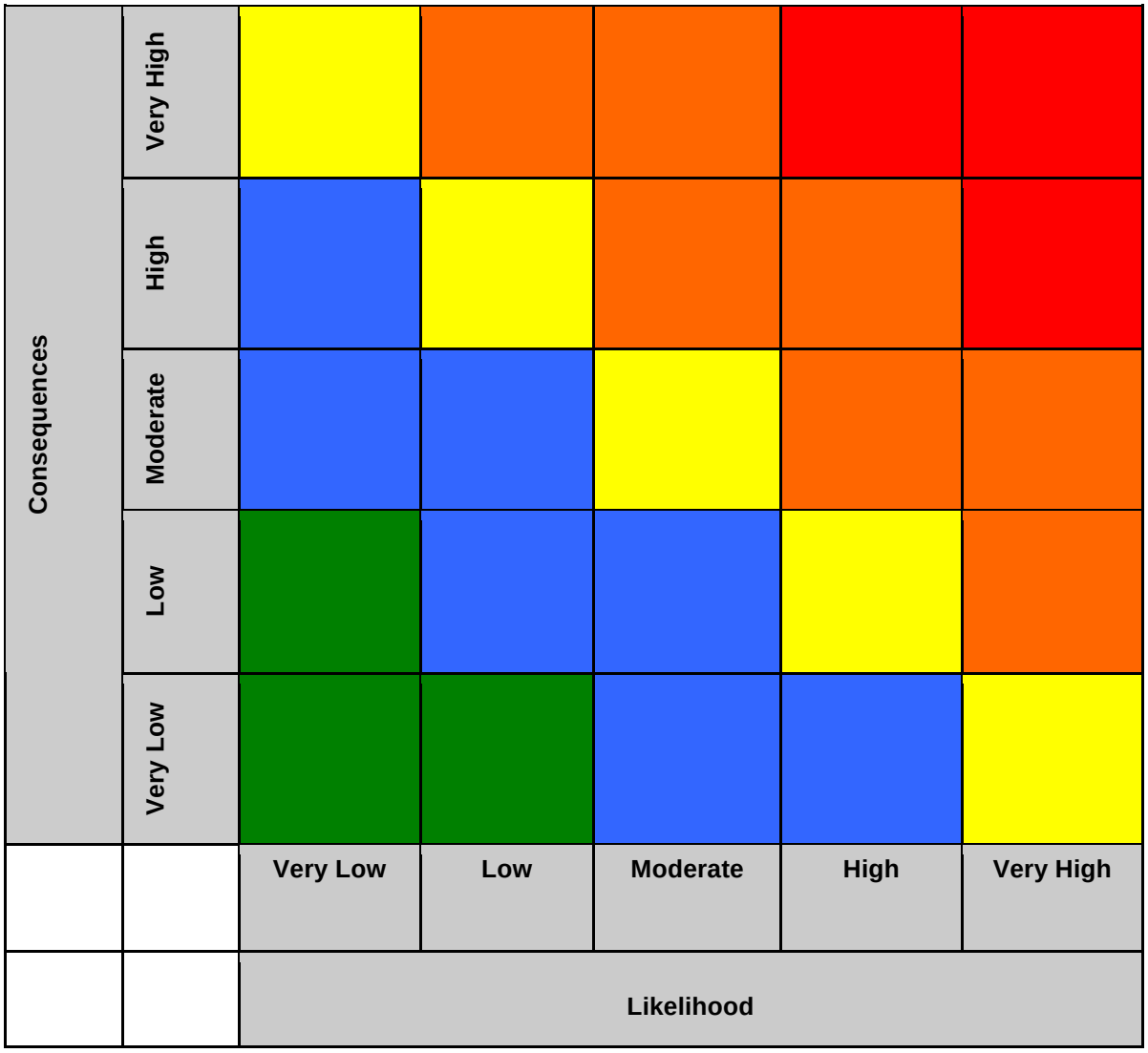
(2) It is helpful at this stage to also consider the costs and benefits of each risk event and any potential opportunities that the climate impacts may present including not only the direct costs and benefits but also the important indirect ones. For example, a shorter freezing period may create problems for winter recreational facilities but it may also bring benefits such as less snow removal costs.

(3) Assess how the principal people or groups that may be affected or involved view the acceptability of risks in your risk matrix.

(4) During the dialogue with stakeholders about their perceptions and the acceptability of the risks, begin to identify risk control options or adaptation measures to help reduce unacceptable risks to acceptable levels. These will be considered in the next step.

(5) Update the data storage system.

Figure 4: Risk Evaluation Matrix (Step 4)



	Extreme Risk: Immediate controls required
	High Risk: High priority control measures required
	Moderate Risk: Some controls required to reduce risks to lower levels
	Low Risk: Controls likely not required
	Negligible Risk: Risk events do not require further consideration

Expected results and outputs

- Risks evaluated in terms of likelihood, consequence, with some sense of costs and benefits.
- Risks ranked or prioritized.
- Unacceptable risks identified.
- Meaningful dialogue has occurred with stakeholders about acceptability of risks.
- Possible risk controls or adaptation measures have been recorded for consideration in Step 5.
- Risk data storage system updated.

Decision

There are three decision options (see the decision diamond in Figure 2 on page 5. End, Go back or Next step/Take action.

- **End** the process if:
  - Stakeholders agree that all the risks are acceptable; or
  - The risks are completely unacceptable, cannot be reasonably dealt with, and all

stakeholders agree that the process should be ended.

- **Go back** if:
  - There is insufficient data or information to make a decision;
  - The principal people or groups that may be affected or involved were not adequately consulted; or not all key stakeholders agree with the conclusions; or
  - There is new information that might materially change the likelihood or consequence estimates.

- Proceed to the **Next Step** if the project team and key stakeholders agree that the risks are unacceptable and that risk control measures will have to be implemented.

Checklist

Step 4: Risk evaluation	
1	Are the evaluations and rankings completed for all risk events and opportunities?
2	Are all of the major considerations accounted for?
3	Have you consulted with key stakeholders on the acceptability of risks?
4	Have you given preliminary consideration to risk controls or adaptation measures for unacceptable risks?
5	Is the risk storage system updated?

For examples of how others have done Step 4 see Step 4 in the case studies in the Workbook.

3.5 Risk treatment and adaptation measures (Step 5):

Purpose

In Step 4 the climate change impacts and the possible risk events or opportunities they could create were evaluated and ranked. Consideration was given to how acceptable the risks were to the municipality, other organizations and principal people or groups that may be affected or involved. For unacceptable risks, some consideration was given to potential adaptation measures or risk controls. Also opportunities were identified and examined for how they could be exploited.

In this step:

- Adaptation measures or risk control strategies will be identified for reducing unacceptable risks to acceptable levels and examined for feasibility.
- Potential opportunities will be considered further for exploitation.
- The effectiveness of the adaptation measures or risk control strategies will be evaluated including the costs (both operating and capital), benefits and associated implementation risks.
- Optimal adaptation or risk control strategies and opportunity exploitation measures will be selected and consideration will be given to the acceptability of residual risks.

What to do and how to do it?

(1) Working with the highest level risk events, identify feasible adaptation or risk control options:
  - Identify all potential adaptation actions that could reduce the likelihood or the consequences of the risks.
  - Typically, an adaptation or risk reduction strategy will consist of a portfolio of measures, for example some shorter-term actions to deal with immediate concerns and some more comprehensive longer-term actions. Together, these measures should offer a cost-effective means for reducing unacceptable risks to acceptable levels.
  - Some examples of risk control measures for climate change issues could include: inspection, monitoring, research, planning, relocation, improved or new infrastructure, changed standards or guidelines, mapping, updating emergency plans, developing capacity and resilience, etc.

(2) Evaluate the adaptation or risk treatment options in terms of effectiveness, cost (operating and capital), residual risks and stakeholder acceptance.
  - Estimate the effectiveness of the proposed options using historical data and the professional judgement of the project team.
  - Identify and assess residual risks caused by the control option.
  - Consider how the municipality, other key organizations, other people or groups that may be affected or involved will view the risk treatments or adaptation options and their perceptions of residual risks.
  - Evaluate the adaptation or risk treatment options in terms of:
    - Effectiveness in reducing losses or impacts or changing probabilities.
    - Implementation and maintenance costs.

- Needs, issues and concerns of affected stakeholders.
- Table 5.1 shown below is a suggested format for displaying this information is.

Table 5.1: Risk Treatment and Adaptation Measures

Risk Event	Adaptation Measure or Risk Treatment (Use as many rows as needed for each event)	Time Frame	Cost	Effectiveness	Acceptability	Comment / Evaluation

Time Frame	Cost	Effectiveness	Acceptability
Short – can be implemented within 10 years	**$** - can be completed within existing or planned budget allocation	**Low** – will have minor effect on risk event	**Low** – significant public/corporate/stakeholder resistance
Medium – can be implemented within 10-20 years	**$$** - will require additional funding	**Moderate** – will have moderate effect on risk event	**Moderate** – moderate public/corporate/stakeholder resistance
Long – can be implemented within 20 – 50 years	**$$$** - will require major additional funding/major capital program	**High** – will virtually overcome risk event	**High** – little or no public/corporate/stakeholder resistance

The costs and benefits of adaptation measures can be difficult to assess, so it is important that the project team has access to the relevant expertise if they need it. An example would be the impact of reduced use of a wastewater treatment facility because of expected higher water levels. To build a new facility would be very costly. In the short term the community might have to forgo other developments. In the longer term, better facilities might strengthen the community's treatment capacity and allow an increased number of residents and businesses without additional infrastructure costs. Also municipalities are very sensitive to whether costs affect their operating or their capital budgets. Any of these outcomes has associated economic, social and cultural costs and benefits that could affect the analysis.

One means the project team could use to assess residual risk is to revisit the consequence rating at Step 3 and consider the change resulting from the proposed adaptation measure(s). This will provide a sense for the effectiveness of the adaptation measure(s) and the remaining risk levels.

(3) Sometimes it may be possible to encourage private adaptations to further reduce residual risks. For example, communities can encourage residents to keep valuables out of lower levels that may flood during a heavy precipitation event. The community can influence the amount of losses from extreme weather events.

(4) Also consider how the identified opportunities could be developed using a similar approach as is used for risk treatments.

(5) Develop a plan to discuss adaptation measures or risk treatments with key municipal people and other stakeholders or groups as appropriate.

(6) Update the data storage system.

Expected results and outputs

- Feasible adaptation measures risk treatment options are identified
- An adaptation plan is outlined for the implementation of adaptation measures.
- The potential opportunities and how they can be exploited has been considered.
- The views of the principal people in the municipality, other key stakeholders or groups that may be affected or involved and their perception about residual risks have been considered.
- Updated data storage system.

Checklist

Step 5: Risk treatment and adaptation measures	
Have you:	
1.	Identified and evaluated feasible adaptation or risk treatment options, in terms of costs, effectiveness, stakeholder acceptance and other criteria?
2.	Selected the optimal suite of adaptation or risk treatment options reduce risks to acceptable levels?
3.	Determined the costs and benefits of the adaptation measures?
4.	Considered how to exploit the opportunities and benefits?
5.	Developed a plan for obtaining the views of key stakeholders about the proposed adaptation or risk treatment measures and residual risks?
6.	Ensured that data storage system is updated?

Decision

There are three decision options (see the decision diamond in Figure 2 on page 5. End, Go back or Next step/Take action.

- **End** if there are no feasible adaptation options.
- **Go back** if:
  - Adequate data are not available for evaluating the cost-effectiveness of potential adaptation measures, risk treatments or potential opportunities.
  - Key stakeholders have not been consulted.
  - Assumptions and uncertainties associated with estimates are not acceptable to stakeholders, or
  - New risks will be introduced if the proposed control options are implemented.
- Proceed to the **Next Step** if:
  - Feasible adaptation or risk treatment options are defined and can be implemented.
  - Proposed actions are feasible from a cost and effectiveness perspective and are acceptable to stakeholders, and
  - Residual risks are acceptable to stakeholders.

For examples of how others have done Step 5 see Step 5 in the case studies in the Workbook.

3.6 Implementation plan and monitoring (Step 6):

Some Preliminary Considerations

The implementation and monitoring component should be considered even in the preliminary overview that is the primary focus of this Guide.

It could be done only in cursory form until the risk management study has been reviewed and approved by the senior administrator or by the municipal council. Or the output from the initial risk assessment and risk treatment study could be a series of recommendations for early low-cost actions to start the adaptation process followed by further studies to dig more deeply into the mid- and long-term consideration.

This is also the stage at which to consider synergisms with other municipal plans and programs such as retrofitting water and sewage treatment infrastructure, rebuilding roads or other municipal or regional programs.

Some of what is discussed below would be required only in a larger study or if the present study is approved to move ahead to a more detailed planning stage.

Purpose

- To develop an action plan or summary implementation and results monitoring plan to ensure that the adaptation measures and opportunity exploitation means are effective and within the expected costs envelope.
- To decide to continue or terminate the risk management process.

What to do and how to do it?

As noted above, the actions to be taken in this step depend upon the objectives of the study. The final output could be an adaptation and monitoring plan, a series of recommendation for municipal council to consider or a scoping study to recommend next steps in a climate change adaptation program. What ever the outputs, some of the following considerations will be appropriate:

(1) Develop the outline of how the adaptation measures and opportunity exploitation means

could be implemented with the following considerations:

- Consider priorities for action,
- Consider the short, medium and long-term financial implications,
- Link the implementation plan to other municipal programs where possible,
- Decide the timing for the implementation of adaptation or risk treatment measures (some risk events may not surface for years, or it may not be feasible to address them immediately),
- Consider what actions are being taken in other jurisdictions and by the provincial and federal governments and whether these would have any impact on this plan or create opportunities for collaboration, and
- Identify special expertise or external assistance that may be required.

(2) Develop the results measuring or monitoring process:

- Establish a date to review or repeat the risk assessment and record it in the data storage system (a five year repetition is strongly recommended for a municipal climate change adaptation study.
- Consider performance indicators that will monitor the adaptation measures or risk treatments. There may be some guidance for other municipal programs that could be applied. Some other suggestions might be environmental measuring, stakeholder reactions, financial costs and benefits. In addition some monitoring considerations may have been suggested during Steps 2, 3 or 4, or during the various stakeholder communications.

(3) Submit the implementation plan for approval.

(4) Continue to communicate with the key stakeholders within the municipality and with other municipalities, groups or individuals.

(5) Record all communications in data storage system.

Expected results

(1) Outline implementation plans or recommendations that include:

- Adaptation measures, risk treatments and opportunity exploitation plans that will reduce climate change risks to acceptable levels and achieve optimal benefits.
- An overview of costs and milestones.
- Linkages with other municipalities, governments and community groups that would benefit the implementation including an information exchange.
- A database of ongoing activities that could facilitate the implementation of the plans.
- A list of key stakeholders that were identified and possibly consulted.
- A list of experts and expertise that was revealed during the risk management process that can contribute to the adaptation measure and risk treatments.
- Mechanisms for training and capacity building in the risk management process and on climate change impacts.
- An evaluation and monitoring process plan including mechanisms for reporting on progress and evaluating results.

(2) Implementation plan ready for submission for consideration by senior management.

(3) Data storage system updated

Checklist

STEP 6: Implementation plan and monitoring	
Have you	
1.	Developed a feasible outline implementation plan or series of recommendations as required by the study objectives?
2.	Identified links with ongoing activities in the community and beyond (e.g. local, regional provincial or national initiatives)?
3.	Identified resources to implement the plan?
4.	Established an effective monitoring and review program?
5.	Submitted the implementation plan for approval?
6.	Developed a communication strategy to support implementation?
7.	Ensured that the risk information library is updated?

For examples of how others have done Step 6 see Step 6 in the case studies in the Workbook.

All the forms and tables suggested in Chapter 3 are available for photocopying and use in the **Workbook**.

4. Conclusions

This Guide is intended to be a tool to help municipalities, regional governments and other organizations make sensible and practicable decisions to adapt to a changing and more variable climate and to consider taking advantages of any opportunities that are presented. As noted earlier, although focussed at a municipal user, the Guide can be and is being successfully used by other levels of governments and other organizations.

It uses a process that is based on an international risk management standard (ISO 31000) that is accepted by governments, senior managers, scientists and the financial community across Canada and in most countries of the world. It also uses some of the very practicable and tested processes of the Canadian national standard on risk management (CAN/CSA Q850). The Guide is written to emphasize the simplicity and practicality of the process and employs a widely recognized likelihood/consequence matrix protocol. It also recognizes that larger or more technical studies of climate risks and adaptation responses may be desired or necessary and the process is equally applicable to these situations. Also see note 1 on page iii for further information about other approaches.

It is not easy to get started; municipal governments have many pressing issues that demand attention and their staffs are torn between conflicting priorities. In spite of mounting evidence that gives credibility to climate change and increasing variability some communities have not fully accepted the need to start now to examine their situations and what the future may hold.

It is also apparent that the costs of climate change are already a burden in every aspect of community life; damages from severe weather events, additional construction costs for unstable soils, upgraded water and waste water systems among others. The sooner that adaptation measures can be implemented the sooner that measures can be developed to control costs related to climate change.

This Guide suggests that some preliminary analyses could be undertaken at little cost that would provide a convincing case for adaptive actions. Municipal officials could use these analyses to promote a higher priority for, and early consideration of, climate risk.

Even though it is evident that climate change is already occurring there is still time to take effective adaptation actions. Climate change predictions indicate that there are major challenges and opportunities facing our communities. The Guide includes a summary of the most important current documentation and a list of references if further research or information is desired.

The risk assessment and treatment process does not end with the first iteration. It requires that the adaptation or risk control measures be monitored and periodically validated and it is recommended that the climate change risk assessment be repeated every five years or whenever significant new information or new technologies that would alter the risk estimations becomes available.

The case studies and examples in the **Workbook** of the Guide are intended to illustrate how to do the process. In order to keep the text as short as possible, the examples have purposely been kept simple to demonstrate the process not the details of the risk. The templates and tables used in Chapter 3 are available for photocopying in the **Workbook**.

Finally, a brief description of the importance of risk perception and a glossary of risk terminology is included. The recognition that different people and organizations perceive the same risks very differently is vitally important to a successful risk management process. Also, differing risk terminology has been and is still being used by various professional bodies and sciences. The glossary of terms that is taken from the standards will provide some relief for users of this guide from the inevitable arguments about terminology.

Annex 1: Climate Change Projections for _____:

INTRODUCTION:

The following summary of observed and expected climate change in _____ is drawn from an extensive literature. Questions of impacts of the changes and adaptation options are not discussed here since they are extensively covered in the publication of Natural Resources Canada, *"From Impacts to Adaptation: Canada in a Changing Climate 2007".*http://adaptation2007.nrcan.gc.ca

1. Factors Affecting Change:

Over the centuries, several natural external forcing factors have resulted in global and regional warming and cooling. These have included changes in the sun's energy reaching earth, and in earth's reflectivity, changes in the number and intensity of volcanic emissions from which suspended particles cause cooling periods. However, about 1850s, man's activities in burning fossil fuels (e.g. coal) and reducing forest cover began to increase the concentrations of the naturally occurring greenhouse gases in the atmosphere. These are gases which permit the sun's energy to reach earth, but inhibit transfer to space of some of the energy from the earth. The net effect is to warm the lower layer of the atmosphere.

The Intergovernmental Panel on Climate Change (2007) reviewed the scientific literature on the relative magnitude of these natural forcing factors and that due to the increasing concentrations of greenhouse gases.

In Fig. 1 from IPCC, the blue bar shows the temperature changes that would be expected from natural factors, the red bar shows the range of temperature changes expected from the increasing greenhouse effect. The black line shows the observed global and North American temperatures. It can be seen that before about 1970, natural forcings were important, but after that, the temperature rise has been driven almost exclusively by the greenhouse gases. They will also be the major driver of climate warming this century.

2. Estimating Future Conditions:

This suggests that the trends in temperature and closely related factors such as precipitation intensities, observed from 1970 to 2010, are a useful foreshadowing of trends for the next four decades. So, one way of considering changes to 2050 is to extrapolate observed trends to that time.

Another way of estimating future climatic conditions is to obtain projections from atmosphere-ocean Global Climate Models, which simulate mathematically, the natural climate system of atmosphere-ocean-land. These mathematical computer models are then run with increasing concentrations of greenhouse gases in the global atmosphere. The rate of greenhouse gas increases used in these simulations is based on emission scenarios developed by IPCC, and by agencies, such as the International Energy Agency. These scenarios try to account for population and economic increases, changes in energy use, deforestation rates and other factors to produce projections of future emissions and concentrations in the global atmosphere.

Intense precipitation event trends are closely related to temperature trends, since a warmer atmosphere holds more precipitable water. This means that when precipitation producing atmospheric conditions are ready to act, they more often produce intense precipitation events. Resent research shows conclusively that more intense precipitation events, widely observed, are related to increased greenhouse forcing, (Min, et al., 2011).

For annual and seasonal precipitation estimates, less confidence can be placed in either extension of the trends or the GCM's, although both can provide indicative information. However, influence of changes in ice cover and temperatures of oceans and lakes and other factors need to be taken into account. This has been done somewhat subjectively, with knowledge of these important interactions.

3. Acceleration of Change:

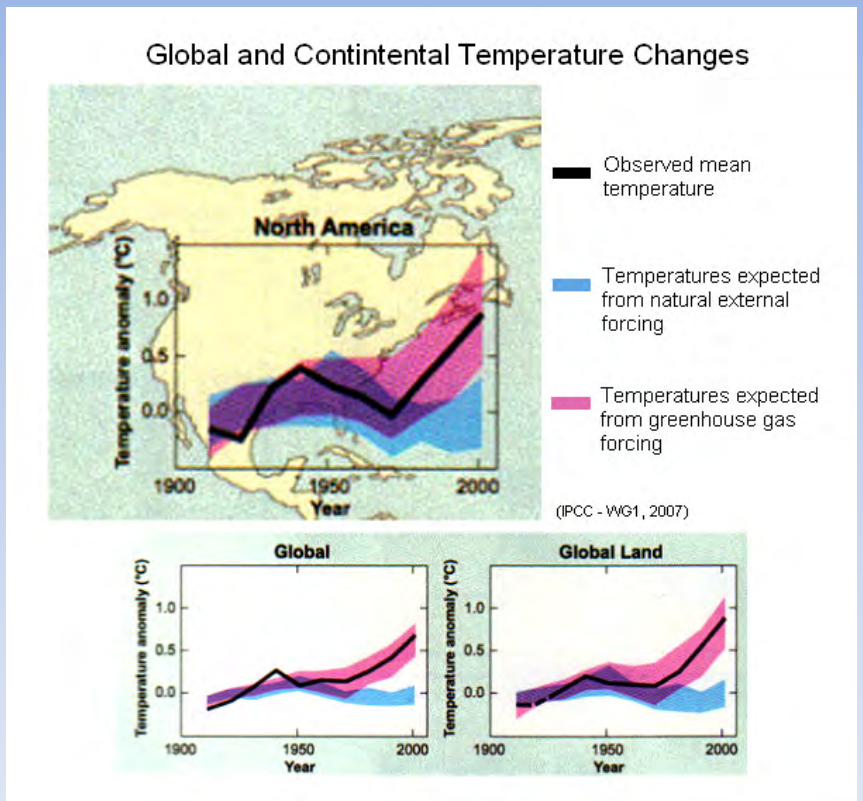
As noted in Section 2, the model results from the highest emission scenarios were used, since the high emission scenarios are the closest to observed trends. Recent information on GHG concentrations, emissions and impacts lead to the view that climate change is advancing more rapidly than estimated earlier. Global atmospheric CO_2 concentration increases averaged 1.6 ppm/year from 1970 to 2007, but

1.9 ppm/year from 2000 to 2007 (Levinson, 2008). From 1990 to 2000, the atmosphere's CO_2 increased at a rate of 3.1 gigatonnes carbon per year but from 2000 to 2008 the rate was 4.1gt C/year (Le Quere, 2009).

At the same time the International Energy Agency in late 2007 reported that global energy use and greenhouse gas emissions have been rising very rapidly. It projects a 55% increase in world energy needs between 2005 and 2030 and a 57% increase in greenhouse gas emissions. This could be tempered by aggressive global efforts to reduce emissions, not evident to date. Of course, the recent economic downturn had a short term effect on this rate of change. It is estimated that in 2009 a reduction of about 1% in global emissions occurred, but 2010 emissions are again on a path to record highs. At the same time, thawing of permafrost and drying of wetlands in the Arctic and sub-Arctic has released more methane, the second most important greenhouse gas, into the global atmosphere, since 2007, (WMO, 2010).

A 57% increase to 2030 is a more rapid increase than the greatest increase in SRES emission scenarios of IPCC, which have been used in previous climate projections. The evidence in the climate system of the acceleration of greenhouse gas emissions and concentrations can be seen in several manifestations. The decline in ice cover in the Arctic has been more rapid than in any of the IPCC scenario modeled results. Ice melt in Greenland, and effects in Antarctica have recently exceeded the rates of change projected by IPCC.

Fig. A.1



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Annex 2: Risk Communications and Perceptions

Introduction[7]:

An individual or a work team that will be making decisions about risk should understand the risk in terms of the needs, issues, and concerns of the affected stakeholders. There will also be a requirement to communicate with a broad variety of individuals, organisations, informal groups, the news media and governments about risk. This Annex provides some insights into the difficulties of understanding perceptions about risk and some thoughts about how to effectively communicate about risks.

Risk Perception - How Different People Value Things Differently:

The value associated with something that may be lost or is at risk differs from one individual to another. It can also differ for the same individual, depending on his or her circumstances at the time. For example, take individual responses to extremely hot weather. A worker in an air conditioned building, who travels to work from an air conditioned apartment complex in air conditioned public transit may not feel much stress or discomfort. On the other hand, an outside worker who lives in an uncooled apartment and drives to work in a car without air conditioning would find the heat very stressful. The two individuals perceive the value of air conditioning quite differently because of their differing needs and priorities at the time. The inside worker would find the risk of losing his air-conditioned environment much more disturbing than the outside worker

This sense of value may also vary a lot depending on the time or other transient factors. For example, the inside worker's valuation of his air-conditioned environment may be substantially lower in the cool early morning than in the heat of the afternoon. If the air conditioning is too cold, it may not be wanted at all. In fact over air conditioning may generate a negative value if the person gets sick from being too cool.

Now consider the risk of losing the air-conditioning completely. If the weather is very hot, the inside worker may find any risk of losing the air-conditioning unacceptable. If, on the other hand, the weather is very cool, he or she may be indifferent to losing the air-conditioning.

The acceptability of the risk depends on the value or utility placed on the item at risk (in the example above, air-conditioning), which depends on the needs of that individual, at that specific time.

Not all considerations of utility are time-sensitive. For example, if we value the environment, we probably always will value the environment. If we are concerned about a changing climate, we will probably always be concerned about the changing climate and how to adapt to it. The terms "needs", "issues", and "concerns" are often used to refer to those factors that affect our perceptions of risk.

Different people can value the same loss differently because the loss may affect their overall satisfaction, or their needs, issues, and concerns, differently.

The issue of perceived value has been often overlooked in dealing with risk situations when the risk is based on the simple equation:

Risk = Probability x Consequence

Many think that this equation is inadequate as a practical definition of risk when the perception or acceptability of risk is included and that a more appropriate expression of risk would be:

Risk = Probability x Consequence x Perception

Consider another example related to the perception or acceptability of risk of lowered water levels in a lake by two communities with different concerns and perceptions. One community derives much of its income and employment from commercial marine traffic in its harbour. Another community, also situated on the lakeshore, values the lake for its scenery and for light recreational use.

[7] This section is based on the discussion of risk perception in CAN/CSA Q850 with changes and additions by the authors of this Guide.

As a result of a changing climate, both communities are told that lake levels are likely to be between 1 and 1.5 metres lower by 2050. The first community will face disastrous employment and economic losses because the main shipping channel for which it is the principal port will be too shallow for the heavy marine traffic that now uses it. An alternate channel with greater depth will still be navigable and another port city would benefit from the shift in traffic.

The impact of lower water levels on the second community would be relatively minor and its shoreline is fairly steep and would still accommodate recreational boating and marinas.

How each community perceives the risk and what kinds of actions will be needed on the part of decision-makers will depend upon the value placed on the impact of the changed water levels. For the first community, huge amounts of resources will be needed to deepen the main shipping channel and the harbour facilities themselves. This in turn may be very threatening to the marine ecosystems in the area. For the second community, very little financial or environmental costs are anticipated.

Even though both communities face the same risk of lowered water levels the first sees this as a major challenge that threatens the viability and economic well-being of its residents. The second views it as a minor inconvenience. Even though the probability associated with lowered water levels is the same, and the consequence of the potential loss is very different.

The acceptability of the risk and how it can vary from one community to the next is not the same because the value placed on the potential loss can differ completely. This is because the needs, issues, and concerns differ widely. Decision-makers often overlook or ignore these differences in perceived value and, as a result, many decisions create controversy.

Risk Communications – How to Talk to People about Risks:

General: Risk communication goes beyond simple messages providing information. It is based on a dialogue that allows stakeholders to participate in the decision-making process.

Some reasons why providing information through simple public relations releases or one-way public education are not useful strategies include:

(a) They will not reduce the conflict that will probably develop concerning a risk and what to do about it,
(b) Because people do not have the same ability to understand and relate to a particular risk, these strategies do not ensure that decisions will be easily understood and supported by stakeholders, and
(c) Providing people with scientific information alone will not enable them or the decision-maker to resolve important risk issues.

Not to communicate with stakeholders or to delay communicating about risk is not an effective strategy and may be very costly in the long term. The reasons are that stakeholders resent responses to risks that are imposed on them and risk decisions made without their input. Most people believe that they have a right to be involved in the decisions that affect them and that the decision-making process should be accessible. Involving stakeholders builds acceptance and can bring out constructive ideas. Effectively communicating about risks is important.

Effective Risk Communication: Effective risk communication is the responsibility of the decision maker, not the stakeholder. The most important benefits of an effective risk dialogue strategy are that it leads to shared understanding, shared goals and better decisions. It builds trust and encourages buy-in by reducing misperceptions and improving the understanding of the science and technical aspects of the risk.

On the other hand, ineffective risk communications may lead to some or all of the following:

- Irreplaceable loss of credibility,
- Unnecessary, costly and possibly bitter and protracted debates and conflicts with stakeholders,
- Difficult and expensive approval processes for projects,
- Diversion of management attention from important problems to less important problems,
- Non-supportive and critical co-workers and employees, and

- Unnecessary human suffering due to high levels of anxiety and fear.

Credibility: Credibility, being seen by stakeholders as trustworthy and competent, is a key goal. The characteristics of credibility include candour, commitment, competence, dedication, empathy, honesty, resolve, respect, and understanding. Credible messages must be based on known facts and with previous statements. They should be framed in stakeholder terms, not self-serving language or jargon, and be consistent with the messages of others. Credibility is very difficult to establish, easy to lose and almost impossible to regain once lost. For this reason some attention to risk communications is recommended prior to initiating the risk management process.
Stakeholders: It can be extremely important to include even minor stakeholders in the process if these stakeholders believe that the outcome of the decision is important to them. These "minor" players may be much more influential than the risk management team anticipates. Even a small group of stakeholders may effectively mobilize public opinion and halt or delay an activity they feel presents an unacceptable risk.

> *For example, a local environmental group rallied to stop a landfill gas collection project being built because they believed the facility could worsen the community's air pollution problem. Even though the risk was very small from a technical point of view the environmental group believed that it was still unacceptable. Because the company sponsoring the project failed to address these specific concerns and even though all the other key stakeholders supported the project, this small group effectively mobilized public opinion against it. The company, after spending a large amount of time, effort, and money, was forced to withdraw its permit request.*

It is important that stakeholders with the potential to stop a project be identified as early in the process as possible.

Regardless of whether stakeholders might actually be affected by an activity or decision, they must be included as legitimate stakeholders if they believe themselves to be affected. These stakeholders may be able to mobilize public opinion against a proposed project regardless of the scientific risk. They may also choose to leave the decision process if they receive enough credible information to understand that the activity really does not affect them.

> *For example, in the landfill gas collection project described above, if the company had analysed the environmental groups' concerns it would have found that their information was based on a number of misconceptions related to some technical and social aspects of the activity. Through a dialogue process, the concerns of the environmental group were addressed, and the misconceptions about the technical issues were corrected. As a result the group's concerns were alleviated and the project went ahead.*

This stresses the need for an effective communication process to facilitate this transfer of information between the decision-maker and other stakeholders.

It is important that the risk management team clearly considers what the stakeholders' needs, issues and concerns are before proceeding with a stakeholder dialogue. There are numerous examples of decision-makers addressing the wrong issue.

> *For example, again in the landfill gas collection project when the company carefully analysed the environmental groups' concerns they believed that the key issue for the group would be emissions from the project. However, through a careful dialogue with the group the company also found out that a secondary issue was related to transportation. The group thought that the new GHG collection facility, because it was the first in the region, would result in a dramatic increase in tourist traffic that would create a risk for their children. Once this and the emissions issues were addressed, the stakeholders were satisfied.*

Trust: Stakeholders often believe that the process of communicating with them about an issue is as important as the eventual resolution of the issue. It is through the dialogue process that the risk management team has the opportunity to gain stakeholders' trust. If the risk management team fails to communicate to the

satisfaction of the stakeholders, trust in the process could be quickly lost.

Research in the area of stakeholder perception has shown that "trust" is a key determinant of stakeholders' acceptance of risk. That is, if stakeholders trust those who are charged with managing the risk, they are more accepting of higher levels of risk. Where this trust is absent, stakeholders demand higher levels of safety, and may refuse to accept any risk at all.

The development of trust between stakeholder and decision-maker is only one of the benefits of an effective communication process. Stakeholders are often the source of information critical to the decision-process.

> *For example, during a prolonged extreme heat episode, a municipality issued instructions through the Chief of Police that people who were suffering heat stress effects should report to the local militia armouries for help. Very few people showed up even though there was a lot of evidence to suggest that many citizens were suffering.*

> *The Mayor had a new announcement put out through the city's Medical Officer of Health for people with heat stress to come to the local high school for help. Most affected citizens responded positively to this announcement.*

The communication process is necessary so that information may be passed effectively from the risk management team to stakeholders. The same process is used to evaluate stakeholder acceptance of risk. Sometimes stakeholders just want to be involved in the decision process so that they can monitor the performance of the decision-maker and to see what is going on. Again, by involving stakeholders "who just want to watch" provides the decision-maker with the opportunity to build trust with these stakeholders.

Annex 3: Glossary of Terms and Definitions

The following definitions apply to the terms used in this Guidebook. The definitions are drawn from the international standard "Risk management – Principles and guidelines" (ISO 31000) unless otherwise specified.

Adaptation – Adjustment in natural or human systems to a new or changing environment. Adaptation to climate change refers to adjustment in natural or human systems in response to actual or expected climate or its effects, which moderates harm or exploits beneficial opportunities. (Climate Change 2001: Impacts, Adaptation and Vulnerability. IPCC, TAR, 2001)

Adaptation benefits – the avoided damage costs or the benefits following the adoption and implementation of adaptation measures. (IPCC TAR, 2001)

Adaptation costs – costs of planning, preparing for, facilitating, and implementing adaptation measures. (IPCC TAR, 2001)

Adaptive capacity – the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or cope with the consequences. (IPCC TAR, 2001)

Adverse effects – one or more of:

- Reduction of the quality of the natural environment for any use that can be made of it;
- Injury or damage to property or plant or animal life;
- Harm or material discomfort to any person;
- An adverse effect on the health of any person;
- Impairment of the safety of any person;
- Making any property or plant or animal life unfit for human use;
- Loss of enjoyment of normal use of property; and
- Interference with normal conduct of business.

Climate change – a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods. (UNFCCC)

Climate impact *– projection of future climatic conditions*

Climate variability – climate variability refers to fluctuations in climate over a shorter term - the departures from long-term averages or trends, over seasons or a few years, such as those caused by the El Niño Southern Oscillation phenomenon. (UNFCCC)

Communication and consultation - *continual and iterative processes that an organization conducts to provide, share or obtain information and to engage in dialogue with stakeholders regarding the management of risk (ISO 31000)*

Consequences *– outcome of an event affecting objectives (ISO 31000)*

Control - *measure that is modifying risk (31000)*

Dialogue – a process for two-way communication that fosters shared understanding. It is supported by information.

Establishing the context - *defining the external and internal parameters to be taken into account when managing risk, and setting the scope and risk criteria for the risk management policy (ISO 31000)*

External context - *external environment in which the organization seeks to achieve its objectives (ISO 31000)*

Event - *occurrence or change of a particular set of circumstances (ISO 31000)*

Hazard – a source of potential harm, or a situation with a potential for causing harm, in terms of human injury; damage to health, property, the environment, and other things of value; or some combination of these. This term is NOT used in ISO 31000 terminology but is in common use and should probably be replaced by "impact"

Internal context - *internal environment in which the organization seeks to achieve its objectives (ISO 31000)*

IPCC – Intergovernmental Panel on Climate Change. A large (several thousand) group of qualified experts which reviews and assesses periodically, all climate change research published in many countries.

Impact – Something that logically or naturally follows from an action or condition related to climate change or climate variability.

Kyoto Protocol – an agreement (1997) under the UNFCCC by most countries of the world, by which most developed countries will begin to limit their greenhouse gas emissions by 2008 to 2012.

Likelihood - *chance of something happening (ISO 31000)*

> NOTE 1 In risk management terminology, the word "likelihood" is used to refer to the chance of something happening, whether defined, measured or determined objectively or subjectively, qualitatively or quantitatively, and described using general terms or mathematically (such as a probability or a frequency over a given time period).
>
> NOTE 2 The English term "likelihood" does not have a direct equivalent in some languages; instead, the equivalent of the term "probability" is often used. However, in English, "probability" is often narrowly interpreted as a mathematical term. Therefore, in risk management terminology, "likelihood" is used with the intent that it should have the same broad interpretation as the term "probability" has in many languages other than English.
>
> NOTE 3 Likelihood generally replaces previous terminology to express the probability of an event occurring; such terms as frequency, probability.

Loss – an injury or damage to health, property, the environment, or something else of value.

Mitigation – used in 2 ways in connection with climate change. It is often used to mean reduction of greenhouse gas emissions in order to slow climate change. It is also used to indicate a measure implemented to reduce impacts (Authors).

Monitoring - *continual checking, supervising, critically observing or determining the status in order to identify change from the performance level required or expected (ISO 31000)*

Organization – a company, corporation, firm, enterprise, or institution, or part thereof, whether incorporated or not, public or private, that has its own functions and administration.

Residual risk *– risk remaining after risk treatment (ISO 31000)*

Review - *activity undertaken to determine the suitability, adequacy and effectiveness of the subject matter to achieve established objectives (ISO 31000)*

Risk *–effect of uncertainty on objectives* (ISO 31000).

Risk analysis *– process to comprehend the nature of risk and to determine the level of risk (ISO 31000)*

Risk assessment *– overall process of risk identification, risk analysis and risk evaluation (ISO 31000).*

Risk attitude - *organization's approach to assess and eventually pursue, retain, take or turn away from risk (ISO 31000)*

Risk communication – any two-way communication between stakeholders about the existence, nature, form, severity, or acceptability of risks.

Risk control option – an action intended to reduce the probability and/or severity of injury or loss, including a decision not to pursue the activity.

Risk control strategy – a program that may include the application of several risk control options.

Risk criteria - *terms of reference against which the significance of a* ***risk*** *is evaluated (ISO 31000)*

Risk evaluation *– process of comparing the results of risk analysis with risk criteria to determine whether the risk and/or its magnitude is acceptable or tolerable (ISO 31000)*

Risk identification - *process of finding, recognizing and describing risks (ISO 31000)*

Risk information library – a collection of all information developed through the risk management process. This includes information on the risks, decisions, stakeholder views, meetings and other information that may be of value.

Risk management *– coordinated activities to direct and control an organization with regard to* ***risk*** *(ISO 31000)*.

Risk management framework - *set of components that provide the foundations and organizational arrangements for designing, implementing, monitoring, reviewing and continually improving risk management throughout the organization (ISO 31000)*

Risk management policy - *statement of the overall intentions and direction of an organization related to risk management (ISO 31000)*

Risk management plan *- scheme within the risk management framework) specifying the approach, the management components and resources to be applied to the management of risk (ISO 31000)*

Risk management process - *systematic application of management policies, procedures and practices to the activities of communicating, consulting, establishing the context, and identifying, analyzing, evaluating, treating, monitoring and reviewing risk (ISO 31000)*

Risk owner - *person or entity with the accountability and authority to manage a risk (ISO 31000)*

Risk perception – the significance assigned to risks by stakeholders. This perception is derived from the stakeholders' expressed needs, issues, and concerns.

Risk profile - *description of any set of risks (ISO 31000)*

Risk source - *element which alone or in combination has the intrinsic potential to give rise to risk (ISO 31000)*

Risk treatment - *process to modify risk (ISO 31000)*

Stakeholder *– person or organization that can affect, be affected by, or perceive themselves to be affected by a decision or activity (ISO 31000)*

Stakeholder analysis – Identification of individuals or groups who are likely to have an interest in the risk management issue including a consideration of what their needs issues and concerns would be and how the stakeholder should be included in the process.

TAR – Third Assessment Report of the IPCC

UNFCCC – United Nations Framework Convention on Climate Change (1992)

Vulnerability – the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is the function of the character, size, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity. (Climate Change 2001: Impacts, Adaptation and Vulnerability. IPCC TAR, 2001)

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