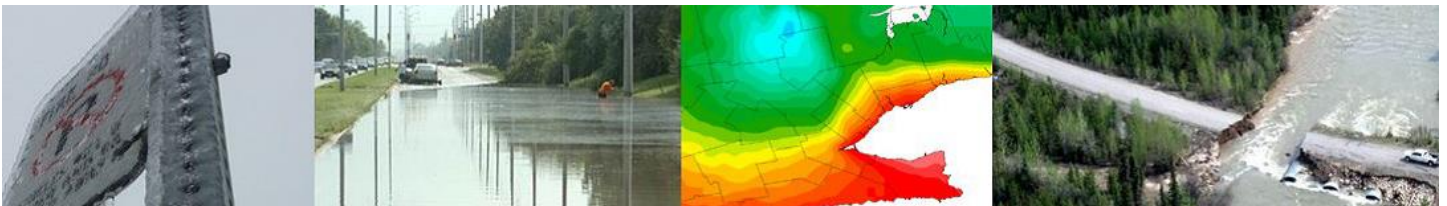


Accessing and Interpreting Climate Change Information for Decision-Makers in Northern Ontario

Final Report

November 25, 2015

Science North
100 Ramsey Lake Road
Sudbury, Ontario



Ontario Centre for Climate Impacts and Adaptation Resources (OCCIAR)

OCCIAR is a university-based resource hub for researchers and stakeholders and provides information on climate change impacts and adaptation. The Centre communicates the latest research on climate change impacts and adaptation, liaises with partners across Canada to encourage adaptation to climate change and aids in the development and application of tools to assist with municipal adaptation. The Centre is also a hub for climate change impacts and adaptation activities, events and resources.

www.climateontario.ca

Risk Sciences International (RSI)

RSI was established in 2006 in partnership with the University of Ottawa. Our mission is to provide clients from both the private and public sectors with the tools and expertise needed to understand and effectively manage risk. RSI draws on a diverse field of subject matter experts to address issues ranging from the use of climate models in the screening of critical infrastructure risks, to environmental health risk assessments for air- and water-borne contaminants, and emergency response planning. In addition to hands-on risk assessments, RSI provides advice on numerous aspects of risk communication and risk management.

www.risksciences.com

1.0 Overview

As stated in the fifth assessment report of the Intergovernmental Panel for Climate Change, impacts of climate change are already being widely felt throughout society and around the globe. Considering the increased skill of climate models in replicating past climate and projecting future change, “due diligence” in the planning, design and management of climate-sensitive systems, such as protected area networks, flood mitigation infrastructure, electricity grids, or others, now implies knowledgeable use of the outputs of these models.

In its report, “Climate Ready: Ontario’s Adaptation Strategy and Action Plan”, the Ontario Government identified the need to make both future-projected, as well as, historical climate information more readily accessible to decision-makers across Ontario. While the Ministry of the Environment and Climate Change (MOECC) has sought to address this need, in part through development of the Ontario Climate Change Data Portal, assessment of the specific needs for application to decision-making and training will be required in order to help mainstream the use of this and other climate change information. This communication aspect was also identified as one of the priorities in the recent Environmental Commissioner of Ontario’s report on climate data.¹

To address this need, a training session was delivered on March 17, 2015 in Toronto with about 100 attendees from a broad range of jurisdictions. The session in Toronto demonstrated a high demand for information on climate change and climate data, as many potential attendees were waitlisted as course capacity was reached. In response to this high demand, a subsequent training session was held to further engage provincial, municipal and other stakeholders and decision makers in Northern Ontario in the inclusion of climate change information in decision making. It also sought feedback on the extent to which climate change information is currently used, sources of that information and how the information can be improved in Northern Ontario.

The one-day, in person training session held in Sudbury, Ontario and was attended by 30 individuals, representing a range of fields and disciplines in municipal planning, policy development, conservation, natural resources management, transportation and infrastructure, research, local government, and public service. The session provided support to practitioners and decision-makers on understanding climate data availability, applicability, and methods to use available data. The session was designed to provide key background information and facilitate exercises and discussions related to:

- Current climate and its historical trends and uncertainties;
- Climate change modeling and theory, including but not limited to:
 - state of the science;
 - time/space resolution issues in modeled and empirical datasets and statistics;
 - characterizing climate means vs. climate extremes;
- Use of climate model ensembles in decision-making, including but not limited to:
 - what can and cannot be “answered” using climate model ensembles and other approaches to identifying climatic change;
 - implications of, and tricks and challenges of working with climate means versus climate extremes in decision-making; and,
 - characterization of uncertainties.

¹ The report is available on the Environmental Commissioner of Ontario’s website: <http://eco.on.ca/connecting-the-dots-on-climate-data-in-ontario/>

In addition, the session included a two-part case study series focused on infrastructure and planning. Specifically, the case studies covered the following topics:

- Legal implications to adapt;
- Policy and planning acts, climate change tradeoffs;
- Requirements for resilient communities, infrastructure and landscapes;
- Future risks;
- Reducing climate risks;
- Examples of projections and adaptation put into practice;
- Municipal and land use planning;
- Engineering forensics, codes, and standards;
- Extreme rainfall events – design values, ecosystem services; and,
- Climate services in support of adaptation.

The goal of the case studies was to provide examples of the application of climate data and climate information in practice throughout Northern Ontario communities.

The training session was also consultative in order to gauge specific climate information needs of participants through a 45 minute discussion period. To prepare, participants were provided a list of five questions two days prior to the session, and participants were encouraged to reflect on their climate information needs throughout the training session (see Appendix A for the list of questions). The stakeholder consultation was facilitated by Al Douglas who posed each question to the group; the discussion and responses were captured by a note taker. The format of the discussion was designed to encourage idea-sharing and interaction among participants and held no limitation on the time or extent to which they could comment/provide feedback.

Finally, a subsequent evening session provided up-to-date information on the science of climate change in plain language for the broader public. The evening session was attended by more than 20 members of the public and was aimed at raising awareness about the science and urgency of climate change.

2.0 Agenda

Time	Topics	Speaker
10:00am	Welcome and Introduction	Al Douglas
10:10am	Current Climate and its Historical Trends and Uncertainties <ul style="list-style-type: none"> • Climate vs weather • Historical trends • Global cycles and natural variability • Recent reality • Ontario observed trends • Extremes and hazards development 	Neil Comer
	Climate Change Modelling and Theory <ul style="list-style-type: none"> • Climate change introduction • Public concern and opinion • Communication of climate change • Intergovernmental Panel on Climate Change as the “expert” • Models as the best available tool • Model development • Emission assumptions 	Neil Comer
11:20am	Break	
11:30am	Use of Climate Model Ensembles in Decision-Making, Including, but not Limited to: <ul style="list-style-type: none"> • Generations of projections • Model ensembles and uncertainty • Global vs regional models in Ontario • Using the Data – best options • Characterizing uncertainty • Extreme variables and their difficulty • Sources of Data – global and Ontario • Climate change assessment approach • Climate change summary • Future of climate projections 	Neil Comer
12:30pm	Lunch	
1:15pm	Afternoon Case Study: Infrastructure & Planning - Part 1 <ul style="list-style-type: none"> • Legal implications to adapt • Policy and planning acts, climate change tradeoffs • Requirements for resilient communities, infrastructure and landscapes • Future risks 	Heather Auld
2:00pm	Break	
2:10pm	Afternoon Case Study: Infrastructure & Planning – Part 2 <ul style="list-style-type: none"> • Reducing climate risks (focus on infrastructure, planning) • Examples of projections and adaptation put into practice • Municipal and land use planning • Engineering forensics, codes and standards • Extreme rainfall events – design values, ecosystem services • Climate services in support of adaptation 	Heather Auld
3:00pm	Questions and Discussion	Team
3:55pm	Closing Remarks	Al Douglas

3.0 Presenters



Heather Auld - Principal Climate Scientist, Risk Sciences International

Heather Auld joined Risk Sciences International (RSI) in 2011 as Principal Climate Scientist after 32 years with Canada's Federal Government. She has worked both with Environment Canada and the Department of National Defence across Canada in climate science, climate services and climate change adaptation, weather forecasting and operations, training, and stakeholder consultations. As one of Canada's foremost engineering climatologists, Heather brings nationally and internationally recognized expertise in climate change impacts and adaptation research, engineering climatology for national codes and standards, energy-climate research, extreme event and forensic analyses, disaster risk reduction planning, and science-policy linkages.

She has served on both World Meteorological Organization (WMO) and International Panel on Climate Change (IPCC) expert groups. In Canada, Ms. Auld is a main climate science advisor to Canada's National Codes Commission, is routinely called upon by industry groups and built infrastructure design standards committees for expert advice, and has provided climate risk-related training to a range of industrial players as well as public sector agencies. She has developed weather hazards information for disaster risk reduction and provided expert testimony to many disaster-related inquiries including the Walkerton Inquiry into water contamination. Ms. Auld has been central to the development of decision-support applications for the interpretation and use of historical climate information, forensic data, and climate model outputs for the purpose of "on-the-ground" decision-making.

Ms. Auld has worked with practitioners and decision makers across a range of sectors, including but not limited to: municipal planning, engineering design, emergency response; airport management and operations; forest management; and, electricity systems, water resources and other infrastructure.



Allan G. Douglas – Director, Ontario Centre for Climate Impacts and Adaptation Resources

Al Douglas is the Director at the Ontario Centre for Climate Impacts and Adaptation Resources, located at Laurentian University in Sudbury. He has been working in the field of climate change impacts and adaptation for 13 years and has partnered with many different organizations in Ontario and Canada to develop and deliver adaptation resources.

Al played leading roles in 2 large, regional climate change vulnerability assessments in Lake Simcoe watershed and in Eco-region 3E-1 (Claybelt) and co-authored an ecosystems climate change vulnerability assessment guidebook for Ontario. Al has contributed content to a host of municipal climate change adaptation guidebooks and specializes in facilitating adaptation planning at the local and watershed level.

He has also contributed content to 2 Canadian National Assessments of climate change and acted as an expert reviewer for the last 2 Intergovernmental Panel on Climate Change assessment reports.

AI has expertise in climate science; climate change impact, vulnerability and risk assessment; policy development and adaptation planning in natural resource sectors.



Dr. Neil Comer – Senior Climatologist, Risk Sciences International

Dr. Neil Comer is RSI's Senior Climatologist. Neil has worked in the private sector as an applications engineer/instructor (Weather Services International) and in the public sector with the Meteorological Service of Canada (MSC) and the Adaptation and Impacts Research Section of Environment Canada (EC). At EC, Neil shared responsibility for developing the Atmospheric Hazards network, and the Canadian Climate Change Scenarios Network (CCCSN), a set of on-line applications supporting the validation and selection of climate change projections for specific climate parameters and geographical locations.

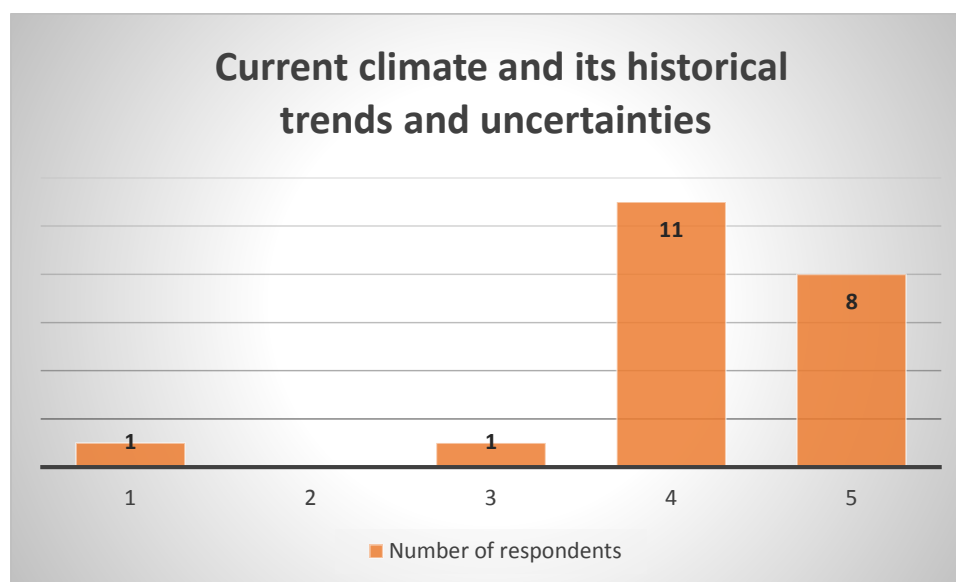
Neil developed and delivered training on CCCSN tools to a broad range of end-users, across all regions of Canada and internationally. Through RSI, Neil now provides analytical services and training to a range of industrial and public sector clients. He is also an adjunct professor at the University of Toronto at Scarborough.

4.0 Workshop Objectives & Outcomes

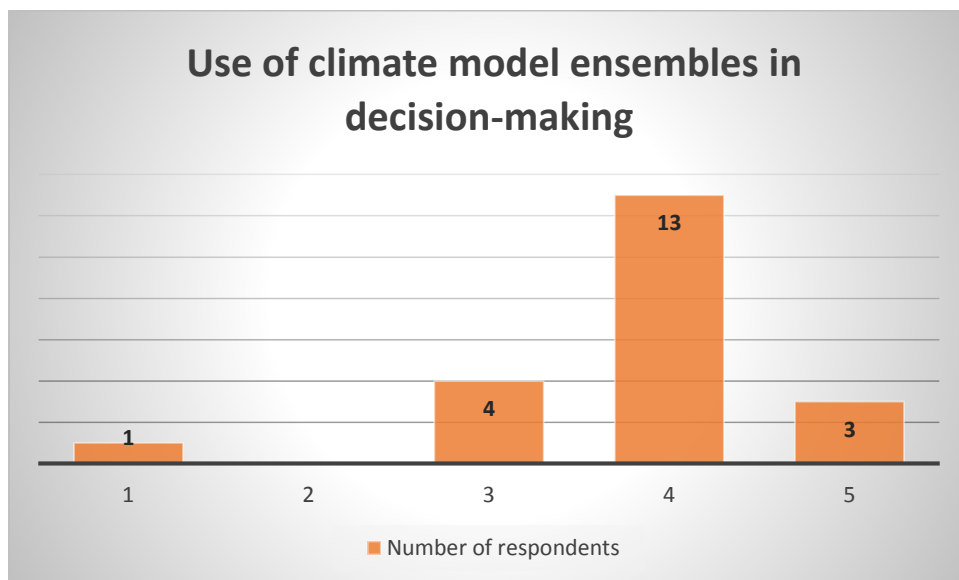
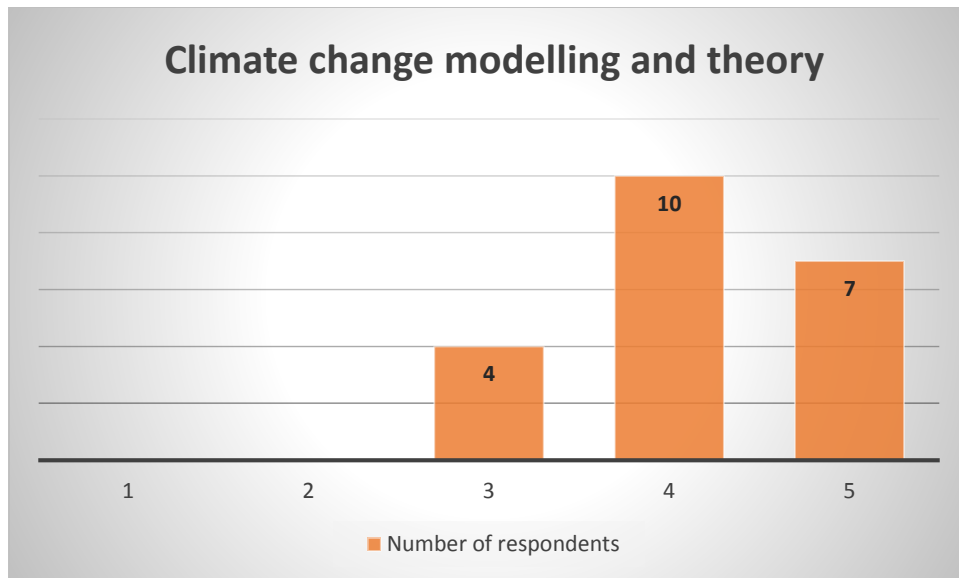
The overall objective of the training session was to improve the knowledge of climate data availability and applicability for decision-making among practitioners in Northern Ontario. More specifically, the session aimed to support mainstreaming the use of climate data and other climate change information by familiarizing participants with key sources of climate data; current climate and its historical trends and uncertainties; climate change modeling and theory; and the use of climate model ensembles in decision-making.

In a course evaluation form² provided to attendees upon completing the training session, participants were asked to rate their level of knowledge on the source of climate data and climate information *prior* to the session and again *upon completing* the session, on a scale from 'very poor' to 'excellent'. Prior to taking the course, almost half of participants indicated a 'fair' level of knowledge (45 per cent). However, upon completing the course, this number dropped to 4 per cent, and the number of responses for 'good' increased from 23 per cent to 45 per cent. One respondent provided the following comment: "I have a clearer understanding of complex issues/data".

The morning session included a series of presentations on specific topics related to climate data and climate information, as presented by Dr. Neil Comer. Participants were asked: "how much did each of the following presentations improve your knowledge and/or awareness of the subject matter?" The degree to which each presentation improved participants' knowledge and/or awareness on the subject matter was gauged using a scale from 1 to 5; with 1 representing 'not very useful/relevant' and 5 representing 'very useful/relevant'. The results for each topic are as follows:



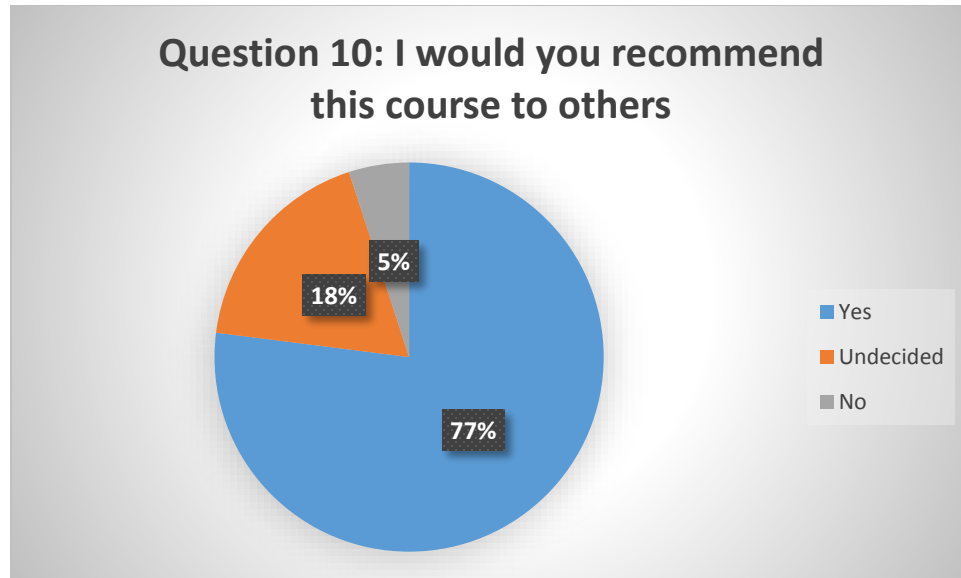
² Results are based on 22 completed evaluation forms.



As a whole, the three areas of subject matter were deemed 'useful and relevant' to 'very useful and relevant' by attendees. Generally, participants entered the session with little to fair knowledge levels on climate change modelling and theory. As such, this topic area of teaching was of particular value to participants.

In addition to the aforementioned topics, the afternoon portion of the training session included a two-part series of case studies, focused on infrastructure and planning. The goal of the case studies was to provide examples of the application of climate data and climate information in practice. The information presented in the case studies were very well received, with 68 per cent of evaluation respondents indicating that the use of case studies helped provide a clearer understanding of the content.

Finally, 77 per cent of participants would recommend the course to others.



Reflected under the comments section, respondents indicated that the session would particularly benefit individuals with a basic to general level of understanding and knowledge on the concepts that were covered. It was also noted that the session provided an important opportunity for different municipalities to work together and to improve their understanding of what data capacities are available.

“The case studies were very helpful for translating science into useable information for policy development”
- Respondent

3.1 Stakeholder Consultation

In addition to providing informative climate data and climate information, the session aimed to assess and understand the climate change information needs of stakeholders in Northern Ontario. This was achieved through a consultation session held at the end of the day. In total, five questions were asked and an additional two questions were formulated by the facilitator throughout the day. Highlights of the feedback and commentary gathered from the exercise are described below:

Climate change hazards and impacts

Throughout the discussion, a number of stakeholders representing diverse sectors (e.g. from agriculture to mining) identified climate change hazards and/or risks that are of greatest concern to their organization. They were also asked to identify impacts to areas of responsibility within their professions. Attendees listed the following hazards, risks and impacts:

- Extreme rainfall and flooding, exacerbated by development in floodplains;
- Drought and/or reduced precipitation that can impact crop and plant production;
- Shifting range of species, vector borne diseases, and the spread of invasive species, with a concern for impacts on native species and biodiversity;

- Concern for industry requirements for reducing emissions from cattle and beef production, and the impact on current best management practices;
- Temperature thresholds and vectors;
- Storm events and designing rehab measures that are going to last for the long-term, such as, the effects of high rainfall events on vegetation; and
- Impacts from drought on mines and mining operations in northwestern Ontario. Practitioners are concerned about developing new guidelines and practices for closing impacted mines, as appropriate.

Current use of climate information for decision making

Next, participants were asked about the current use of climate change information that support decision-making. Stakeholders discussed using climate projections and future climate changes in order to guide agricultural and conservation practices, such as re-greening efforts, ecological coverings, and informing types of crops that may become vulnerable to future climate disruptions. Additionally, climate change information could be used in a climate hardiness database for the use of forecasting and planting accordingly. For example, the use of climate projections to plant according to conditions that are expected for the year 2050.

Climate projections on temperature and precipitation thresholds were also mentioned in the application of water resource protection and conservation, specifically in water quality and quantity. It was particularly noted that the role of uncertainty in climate projections induces challenges in decision-making and planning.

Climate services and information needs for decision-making

In addition to the current use of climate information, the need for other climate services and information was also discussed. Stakeholders noted support for advising infrastructure planning and management for future climate changes – the example of ‘low-risk’ techniques presented in the case studies was highlighted by the stakeholder as a principally useful tool.

Another area of need was a set of cohesive guidelines and recommendations for the types of models that should be used that are sector specific, such as stormwater. Further, recommendations for managing variability and limitations in models was mentioned as an area of need. There is also a particular need for climate data on a regional, downscaled level. Sharing best practices and case studies was a specific suggestion for overcoming challenges and promoting collaboration and learning from other stakeholders.

The translation of climate projections and their impact on run-off, hydrology etc., was of noted interest. Although not data specific, one attendee mentioned the importance of perceived climate risk among the public compared to actual risk. They elaborated by pointing out disconnections between science and the information that is shared/available to the public, and especially, the influence on policy makers, planners and council decision-making.

Lastly, the importance of reliable data was discussed. A practitioner asked: “is it possible to incorporate high intensity duration rainfall data with climate models, and is it accurate/trustworthy?”

Resources needed for managing climate change uncertainties in decision-making

Stakeholders were prompted about the resources they need for managing climate change uncertainties in decision-making, such as, web-based content for general or specific information, information extension services, risk management frameworks, etc. A list of resources that were discussed are provided below:

- Communication, education and outreach;
- Online resources;
- Posters or information sheets for communities, similar to those resources that are provided to teachers;
- Resources for communicating climate change information;
- Synonyms or alternate terms to describe 'climate change', as it's possible that the word has been exhausted among the public; new terms that could be applied to certain sectors, such as climate risk management;
- Guidance material for municipal planning, such as, climate change mitigation, adaptation case studies;
- Additional information on extreme heat events and the potential implications on forest fires, agriculture and fish species, which might be underestimated;
- Support for managing and incorporating climate change into other areas of concern (e.g. emergency preparedness), among rural communities; and
- Support for communicating impacts to various levels of authority.

The role of climate change in environmental assessments

The facilitator asked if there have been any inclusion of climate change in environmental assessments. It was discussed that projects at the federal level are beginning to consider it, but in general, is lacking guidance. At the provincial level, certain ministries are preparing guidelines for large projects, such as a mine development projects, but not necessarily among smaller, Class A projects. Lastly, climate change language is starting to appear in new drafts for Class EA's at the Ministry of Natural Resources and the Ministry of Environment and Climate Change is requiring that all new class EA's include climate change, however, guidance remains weak.

Barriers to accessing data

Participants were asked if what barriers they've experienced accessing data presented in the training session needed by practitioners. Barriers mentioned included:

- Pressure from other sectors and requirements set out in municipal plans and policy;
- Constant development pressure and expensive development that is not as useful in the north as elsewhere. For example, the misguided perception that wetlands have little to no value;
- Local media and their unbalanced reporting/representation on climate issues;
- Varied interpretation of climate change among different players, such as a disproportionate level of understanding by different sectors; and
- Treating climate change as a separate issue/task as other priorities and action items when they should be mainstreamed within them.

Final question: "If this session was offered to your colleagues, is there any additional information that would be helpful?"

As a wrap-up to the consultation exercise, attendees commented on additional information that they would be interested in or find useful. One attendee stated:

"If there was a part 2 wish list, I would be incredibly interested in mitigation strategies for lower population communities in the north. The municipalities doing adaptation are larger, so how are they different for farther communities, even those with lower socioeconomic communities. What does it look like for us?"

Additionally, one stakeholder suggested a jurisdictional scan on the support that exists for communities or countries in adapting to climate change and how they are adapting. Lastly, access to regional data was pointed out as an area of sustained interest, including the challenge with data that is provided on a large scale, but is unusable/irrelevant for decision-making at that scale.

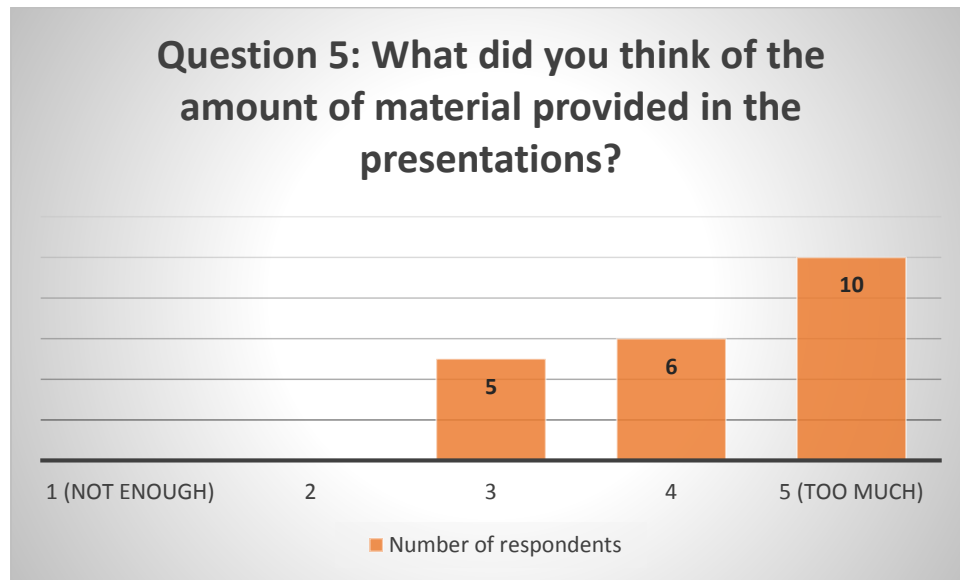
4.0 Lessons Learned

A particularly common area of feedback surrounded the need for key take-away messages at the end of the day's session. This feedback resonates with comments concerning the complexity of information provided on data models and theory.

Although more than half of attendees were satisfied with the content covered in the training session, sufficient interest in additional material was noted, including:

- Information targeted to policy-making;
- Specific examples from a range of sectors (e.g. forestry, mining, natural resources etc.) to demonstrate the breadth of potential climate impact;
- Examples of success stories;
- Support in applying the use of data to municipal adaptation planning; and,
- How/if government agencies are using climate data.

In addition, attendees felt the information was presented clearly, but was content heavy for a single-day event. When asked to reflect on the amount of information provided in the presentations, roughly 50 per cent of attendees³ indicated it was 'too much'⁴.



³ This question was left blank by one respondent

⁴ With number 1 representing 'not enough' and number 5 representing 'too much'

One attendee recommended the use of interactive, participative activities throughout the session as a method to enhance learning.

For many, opportunities for additional resources on climate data and climate information was of high interest. One respondent recommended repeating the session in one year's time to provide an update on the status of climate data in Ontario. Upon completing the training session, only few participants remained unclear, confused and indicated a general lack of awareness on sources of climate data in Northern Ontario.

5.0 Summary

As indicated in the course evaluations, participants demonstrated an increased level of knowledge on climate information and climate data upon completing the training session. In particular, participants noted an improved understanding of the disadvantages/advantages of various methods and types of models used in future climate projections (e.g. the use of ensembles). Furthermore, participants provided positive feedback on the use of case studies as a tool for translating science into useable, plain language information for use in policy development and other decision-making scenarios.

Throughout the course evaluations and individual in-person discussions, attendees expressed satisfaction with the training session and felt a valuable outcome was the opportunity to engage with other stakeholders in Northern Ontario, to network, and to build relationships that could lead to collaboration.

As a whole, the training session successfully familiarized participants with key sources and concepts of climate change data and information. However, it is clear that a knowledge-gap and an appetite for additional information, recommendations and general guidance remains among decision-makers in Northern Ontario.

Appendix A

List of Questions for Discussion

1. What climate change hazards and/or risks are of greatest concern to you and/or your organization? What are the top 5 impacts to areas that you are responsible for in your job?
2. Do you currently use information on climate change to support decisions in your job? If so, where do you obtain this information?
3. What other climate services/information do you require to support your decision-making, planning, or infrastructure design and asset management?
4. What resources do you need to manage climate change uncertainties in your decision-making? E.g. web-based content for general or specific information, information extension services, risk management frameworks, etc.
5. If this session was offered to your colleagues, is there any additional information that would be helpful?

Additional questions posed by the facilitator:

1. In regards to environmental assessments: have there been any inclusions of climate change in environmental assessments?
2. Are there any barriers? What is standing in the way from using the data we saw today; things we need today