

Exchanging Ideas on Climate Change in the Yukon

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In May, 2000, the Northern Climate ExChange (NCE) hosted a workshop in Whitehorse called Taking Action on Climate Change in the Yukon. The workshop provided an opportunity for individuals and organisations in the Yukon to identify what needs to be done to address climate change in the Yukon, and to identify the role of the NCE in carrying out this work. Participants of the workshop recommended that the NCE visit Yukon communities to record community observations on climate change, and discuss what should be accomplished in the Yukon to tackle climate change in the short and long term (Ogden, 2000).

A report, called ExChanging Ideas on Climate Change in the Yukon (Ogden, 2001) was prepared to summarize the discussions that took place in Yukon communities on climate change. The report includes an overview of the Yukon climate, as well as climate change scenarios and model projections for the Yukon, and contains a record of the observations and concerns that were shared with us. The following paper summarizes this work.

Methodology

The NCE discussed climate change with individuals and organisations in communities across the Yukon during the summer and fall of 2000. The approaches to our discussions varied among communities. One or more of the following approaches were employed, depending on community-identified needs and desires, and available resources.

Public information sessions were held in Watson Lake, Teslin, Faro, Dawson City, Mayo, Haines Junction, Beaver Creek, and Burwash Landing. Local stakeholder groups in each community were approached (government, industry, educators, band resource officers and community groups etc.) to schedule one-on-one meetings.

Sessions in workshops and conferences were hosted by the NCE, including the Moose Creek State of the Environment Workshop, the American Association for the Advancement of Science Conference (Arctic Division), and the Yukon North Slope Conference.

The February 2001 workshop Climate Change in the Central Yukon was co-hosted by the Village of Mayo and the Nacho Nyak Dun First Nation, and

the NCE.

Our discussions were open-ended. Some topics we discussed were:

- What is climate change and why is the climate changing?
- What climate and environmental changes have you observed in your community?
- How do local observations compare to the climate change scenarios presented for the Yukon in the Canada Country Study?
- What are your concerns about a changing environment?
- What should we do to address these changes?
- What types of information do you need to take action on climate change?

We also explored local and regional priorities for action on climate change. Discussions arose about climate change research, impact monitoring, data management, education, technology development, adaptation, and policy. These discussions also contributed to one of the projects underway at the NCE, which is to define the quantity and quality of available information on the impacts of climate change in the North, and develop an information system for northern communities to share information on climate change (Gill et al., 2002).

Climate of the Yukon

Climate, the 30-year average of daily and seasonal weather patterns, has been a major factor in the settlement, development and evolution of the Yukon. Long before the Yukon became a territory in 1898, Yukon First Nations survived in this region for generations due to their strong understanding of the natural environment. Climate influenced the resources upon which First Nations were dependent, and shaped Native culture and settlement patterns.

Yukon climate, like its topography, is varied and complex. Greatly influenced by the proximity of the Pacific and Arctic Oceans, rugged topography, and northerly latitude, the Yukon is broadly classified as having a sub-arctic continental climate.

The Yukon lies between 60° N and 69° 39' N latitude. This northerly latitude limits the amount of incoming solar radiation, and influences the type and frequency of weather systems that reach the Yukon. Solar radiation, which varies by altitude and latitude, influences snowmelt, evaporation, and growth of vegetation and, of course, human comfort.

Climatic variability in the Yukon is greater than anywhere else in Canada, resulting from effects such as changing elevation, aspect, and differences in air masses coming into the territory. The Yukon holds the record on the continent for extreme low temperature, -62.8°C degrees at Snag; yet its summer extreme maximum of 36.1°C at Mayo, due in part to the long hours

of daylight, is comparable to summertime highs much further south. The mean annual temperature is below zero in all areas. Precipitation in the territory varies substantially with latitude and elevation. Winds are strongest in southwestern Yukon (average approx. 13 km/hr) and on the Arctic coast (average approx. 19.3 km/hr), though the topography exerts strong local influences throughout the territory. A detailed description of Yukon climate is found in *Climate of the Yukon* (Wahl et al. 1987).

Long-term collection of climate data is essential to understanding local and regional dimensions of climate change. In the 1980s, the Yukon had 66 stations monitoring various climatic parameters, however, in the 1990s funding cutbacks reduced the number to around 40. Only 6 of stations contribute long-term climatological data, with continuous records longer than 30 years. Dawson began intermittently recording weather information in 1897, with continuous recording since 1901. In 1925, intermittent observations began in Mayo, Haines Junction, Whitehorse, Teslin and Watson Lake, which became continuous in the late thirties and early forties.

Is the Yukon Climate Changing?

Global average surface temperatures have increased by about 0.60°C over the past 100 years (Taylor and Taylor 1997). This warming has not been uniform across the globe, and the greatest amount of warming has been observed in the upper latitudes of the northern hemisphere. In the Yukon, there is a clearly identifiable warming trend of about 1.5 °C over the past century. Most of this warming has taken place in the past two decades. Warming has occurred mainly in winter and spring, a very weak warming trend is exhibited in the summer, and autumn temperatures have been gradually decreasing. Precipitation trends are more difficult to discern. There is an average decrease in winter precipitation while summer precipitation is somewhat higher and apparently more variable (Bullas, 2000).

Climate normals are a useful way to examine long-term trends in climate data. Table 1 (see below) compares temperature normals for Mayo, Watson Lake and Whitehorse for the 1951-1980 and 1961-1990 periods. At the time of this publication, climate normal data are not yet available for the 1971-2000 period. McCoy and Burn (2001) completed a thorough investigation of climate and environmental data for the central Yukon. The data demonstrate an annual increase of 0.15 °C per decade since 1925, with most warming taking place in warming in spring and summer and no a significant trend in fall and winter temperatures. Since 1927, total annual snowfall in Mayo has increased at a rate of 10.4cm/decade, with no observable trend in total annual rainfall.

Table 1
Mayo, Watson Lake and Whitehorse Normal Mean Monthly Temperature
for 1951-1980 and 1961-1990

	Mayo		Watson Lake		Whitehorse	
	1951-80	1961-90	1951-80	1961-90	1951-80	1961-90
January	-29.0	-26.9	-26.7	-24.6	-20.7	-18.7
February	-19.9	-19.4	-18.7	-18.4	-15.2	-13.1
March	-11.7	-10.4	-11.3	-10.5	-8.2	-7.2
April	-0.4	0.0	-0.6	-0.4	0.3	0.3
May	7.5	7.9	6.9	6.9	6.7	6.6
June	13.4	13.6	12.7	12.5	12.0	11.6
July	15.2	15.6	14.9	14.9	14.1	14.0
August	12.6	12.8	13.1	13	12.5	12.3
September	6.5	6.5	7.6	7.4	7.5	7.3
October	-2.3	-2.2	-0.1	-0.1	0.6	0.7
November	-15.2	-16.8	-13.8	-15.3	-8.8	-10.0
December	-24.2	-25.5	-23.5	-22.9	-16.6	-15.9
Annual	-4.0	-3.6	-3.3	-3.1	-1.2	-1.0

Climate models consistently predict increases in temperatures year-round and increases in snow for the Yukon. Winters are predicted to warm more than summers, with the winter warming being greater the farther north you go. Conversely, because of the moderating effect of the Beaufort Sea, summers are predicted to warm up more in the south and central Yukon than in the north. Predictions for precipitation are considered to be more uncertain than predictions for temperature change. In general, models predict increased winter precipitation for the Yukon (as with winter temperatures, the change is predicted to be greater the farther north you go). Most models predict little change in average summer precipitation levels. More and bigger storms are predicted for the Yukon—both winter storms and heavy summer rainfall storms, with more thunder and lightning (Taylor and Taylor 1997).

Observations and Concerns about Climate Change in the Yukon

Yukon residents are reporting changes to their environment, economies and social conditions that are directly or indirectly related to a change in climate. The following summarizes the discussions that took place in communities across the Yukon in 2000. Additional information is available in the report *Exchanging Ideas on Climate Change in the Yukon* (Ogden and Munier, 2001).

Mayo/Central Yukon

Mayo residents have specific concerns about climate and environmental change, including land stability, municipal infrastructure, water levels (in particular as they relate to the hydroelectric dam), fish and wildlife manage-

ment, and forest management. At the Moose Creek State of the Environment Workshop, timing of seasonal changes were discussed, and concern was expressed about how climate change would affect the timing of these changes. There were concerns about what types of decisions can be made about climate change, and who should be making these decisions.

Central Yukon residents also had ideas about what should be done to address these climate change. Education about climate change and why it is happening, in particular for local youth, was recommended by some as a top priority. Some suggested that future work needs to focus on how we adapt to changes in our environment. Others suggested that humankind needs to reflect on their actions, and incorporate spiritual teachings, Traditional knowledge, and scientific research into action plans.

Dawson City

Dawson City residents were concerned about several aspects of climate and environmental change. Fisheries (in particular salmon) are a major concern for some residents, in particular uncertainty about how environmental changes will impact fish population levels. Some residents pointed out that the town dyke was built to withstand a certain level of flooding, and wondered how reliable this dyke will be in the future if water levels rise. They were also aware that permafrost in the area is “warm” or close to its melting temperature. Small changes in ground temperatures make infrastructure, notably the underground sewer system and valuable heritage structures, vulnerable to destabilization. One resident noted that there are millions of dollars at stake should land instability result from climate change. Other residents wondered how forest fires and tourism will be affected by climate change, and some questioned if new agricultural opportunities will arise.

Faro

Faro residents discussed past experiences of unstable ground related to permafrost warming and how this affected the local hotel and school. From these experiences, lessons were learned on how to construct foundations to prevent problems under these conditions. However, it was pointed out that the permafrost issue is not a new but rather an ongoing issue, and some residents wondered if lessons learned will apply under future conditions. One resident wondered if the new species and greater abundance of mushrooms will provide new economic opportunities. Another resident questioned if warmer winter temperatures will have economic implications for fur bearing animals because of thinner fur. Others were concerned about the collection of data to monitor changes, and there was interest by some residents for local monitoring.

Municipal staff indicated their support for local research, education and

capacity-building on the climate change issue and are keen to work in partnership on any worthwhile projects that may arise. Some of the topics suggested for research were tourism, wildlife management, fuel cell research, documentation of traditional knowledge, and monitoring. Village staff also had ideas about on how to proceed with addressing the climate change issue locally. They suggested that a local person or agency be identified to explore opportunities, needs and options for local climate change-related work in the area.

Watson Lake

Some Watson Lake residents shared ideas about what should be done to address climate change in the region. One resident noted that trappers in the area have decades of experience, a wealth of knowledge, and valuable journals of information relating to conditions on the land. This information should be reviewed to improve our understanding of “natural” variability, to better grasp the impact of current climate warming. Some residents expressed an interest in establishing ongoing monitoring projects, in the Watson Lake area, that would complement existing monitoring on rabbits, birds and small mammal populations. They suggested such a program should include monitoring of changes in vegetation, and how these changes affect other ecosystem components. However, it was noted that at present there is neither time nor resources to initiate this type of work, and suggested it could be coordinated across the Yukon through a larger agency. Another resident recommended that educational programs should link climate change to forestry issues. Forestry is one of the greatest issues of concern to residents of Watson Lake, and more people may become engaged in the climate change issue if it is related to forestry in a concrete way.

Teslin

Residents of Teslin have noticed fewer porcupines in the area, and less salmon. Mushroom pickers around Squangva have found mushrooms in July that usually come out in the fall. More rain than usual was noticed during the summer of 1999 and 2000, as well as a reversal of spring and summer in 2000 (hot sunny spring and rainy cooler summer). These unusual spring and summer weather conditions prevented berries from developing.

One resident pointed out that there is currently little discussion about climate change and how to address change in the Teslin area, though there is interest in the issue. A number of concerns about climate change impacts emerged, including whether or not frost-heaving will cause more problems in the future for pipelines, highways and powerlines, if salmon populations will continue to decline, and whether climate change will impact mining operations or abandoned mine sites. A number of residents suggested that

their Elders may be good information sources, and encouraged the collection of Traditional knowledge on climate change within the Teslin Tlingit territory.

Haines Junction

In the area around Haines Junction, local residents have observed that high water levels are causing nesting swans to lose more young, so they are moving away from nests on local lakes. The severe spruce beetle infestation in the area is believed by some to be due to mild winters and low precipitation in summers of the last decade. Beetle-killed spruce trees open the forest canopy, and different plants are growing where spruce had previously grown. Some residents speculated that crusting and ice in the snowpack is responsible for a decline in numbers of gophers, grouse, and sharp-tails in 2000. An increase in extreme weather events was noted, and examples were given including the warm spell and rain in late December 1999, and high precipitation in summer 2000. Residents have also noticed that many leaf-miners were found in poplars this past year.

Some specific concerns were raised about impacts of climate change in the region. For example, if warming continues, will melting of discontinuous permafrost in northern Aishihik affect habitat (for example, ground squirrel)? Does increasing leaf-miner populations have implications for fire behaviour, since poplar stands can act as fire breaks? As glaciers retreat, will lake trout and other organisms that depend on this steady source of fresh water be affected, for example in Dezdeash Lake and streams that flow into the lake? On a positive note, some residents expressed an interest in emerging opportunities for agricultural production in the area that may arise as climate changes.

Burwash Landing

Residents of Burwash Landing have noticed higher water levels in the local rivers, and high lake levels in 2000 that washed out the highway. One elder said the water levels were the highest he has ever seen. Others have noted fewer sightings of lambs, caribou, fox, rats, geese, salmon and moose. Lake trout numbers also appear to be down. Residents have noticed warmer winters and summers than usual, and one elder remembers 1973 as being the last “normal” year in terms of temperature, freeze-up and break-up patterns.

Beaver Creek

Residents of Beaver Creek have noticed that the highway is being damaged by substantial amounts of frost heaving, and sometimes large potholes and bumps seem to appear overnight. The need for road maintenance is increasing significantly. Winters also appear much milder than in previous years.

Whitehorse

Whitehorse residents have also noticed warmer winters, and recently more rain in summers than usual. Some reported seeing insects they have never seen before, indeed, one resident reported seeing of Monarch butterflies. In the past few years, it has become more difficult to forecast hydro power capability. Other residents were worried about the community impact on the levels of greenhouse gases in the atmosphere, and wondered about the effects of future oil and gas development as well as methane emissions from the municipal landfill.

At the “Taking Action on Climate Change in the Yukon” workshop in Whitehorse in May 2000, participants made specific recommendations for governments, communities, industry, and researchers on the climate change issue:

- Governments need to consider climate change in management agreements for natural resources and environmental impact assessments for development projects, and need to encourage and support community-based monitoring and archiving programs.
- Communities need to participate in monitoring programs and begin discussing strategies for adapting local infrastructure to a change in climate.
- Private sector industries such as forestry, transportation, mining, construction and oil and gas need to include climate change considerations in research, planning and design of projects such as pipelines, dams and tailing ponds.
- Researchers need to consider developing a centralized archive of data relating to climate change and consider community needs in the design of research programs.

North Slope

At a session of the North Slope Workshop in September 2000, we discussed what people do, and what concerns they have about climate change. The question ‘so what?’ was used to challenge most comments, to keep the focus on practical applications of climate change research and knowledge as it relates to the communities’ seasonal activities.

In this workshop it became clear that wind is of fundamental importance to most of the activities occurring on the North Slope, and there are observations of windier summers in recent years. Wind brings in ice and takes it away, it is the main control over storms and water levels, and thus affects everything from human safety, water levels and erosion rates, to air traffic, and sea traffic west of Kay Point. It was noted that planning adaptive stra-

tegies to harvest whales in rougher waters may be a good idea, but the idea of having bigger boats that could be out in storms would not be helpful as Beluga are difficult to spot in whitecaps no matter how large a boat one is using.

Other aspects of life that are important to North Slope residents and could be affected by climate change were discussed by workshop participants. Landslides and erosion on the coast cause land recession, affecting nesting bird habitat, and muddying of water, affecting fish populations. There have been observations of change to local populations of char, herring and salmon. Tundra wetness affects the ability to skidoo in the summer affecting caribou hunting, and thinner ice causes extra risk and less security in winter travel.

Discussions at this workshop clarified priorities: a better understanding of changes to wind patterns, storminess, ice dynamics and a better understanding of these climate impacts on coastal fish and bird habitat is required. The Wildlife Management Advisory Council's North Slope Research and Monitoring Plan provides additional direction on actions required to address climate change in the region.

Conclusions

In the Yukon, climate change has emerged as a major area of public concern, and is now receiving considerable attention in the territory and across the Canadian north. Climate change is not new, but the rate at which it is currently occurring is believed to be unprecedented. How will climate change affect wildlife, hunting and trapping, and other activities in the Yukon? How should we approach the challenges that climate change has presented to us? This work provides some insight into the local dimension of the climate change issue, and the following general conclusions have been drawn.

Climate change is no longer an abstract idea in the Yukon. There is a high degree of awareness and concern about climate change in the Yukon. This may be a reflection of considerable media coverage devoted to this issue, the availability of traditional and local knowledge, the growing accessibility of research results, and/or to a strong connection to the land.

Public opinion on what to do about climate change varies. Despite the high degree of awareness, there are widely varying opinions on how serious the issue is, and what should be done to address the issue. Some of the opinions shared with us include

- "I am overwhelmed by conflicting information."
- "It is going to happen anyway."
- "It is going to be very hard on us."
- "There is nothing I can do."

- “Northerners aren’t the cause of the problem.”
- “It is not as bad as they say.”
- “Some technology will be developed to fix the problem.”

There is a tremendous amount of local information on climate change, but very little of this information is documented. The primary goals of this work were to gauge the degree of understanding of climate change in Yukon communities, and to identify local climate change issues, observations, and concerns. We discovered that a wealth of local observations exists, but in many cases, have yet to be recorded in a systematic or comprehensive fashion.

People are concerned about what they have observed. Many individuals we spoke with are disturbed by what they consider to be severe climatic and ecological changes, and many report that the changes they are witnessing are unprecedented.

There are more questions than answers. When it comes to deciding what to do about climate change impacts, there are more questions than answers about what changes to expect, and what to do to respond to these changes.

There is a paucity of information to assist communities with understanding and preparing for climate change impacts. We discovered that there are problems with the available information on climate change, ranging from inadequate monitoring of environmental conditions to restrictions on information access. From this poor information base arises considerable confusion about how to address climate change impacts.

Very little research is available on a scale that is useful to community-level decision-making processes. Many lament the paucity of available studies on the probable impacts of climate change at local and regional levels, and that even fewer studies exist that provide guidance on adaptation.

Local observations on climate change are extremely valuable. Local observations can assist in pinpointing areas of research, provide a “window” into impacts of climate change at a local level, and identify issues that require attention.

Observations and concerns on climate change vary among and within communities. There are subtle local and regional differences in observations on climate change. It is apparent that variations in culture, economy, and location mean that climate change will impact communities in different ways. The concerns expressed about what impacts climate change will have on local economic and social conditions tend to be a reflection of unique local circumstances.

Community observations and model predictions on climate change are not always the same. Both models and local information indicate that the Yukon climate is indeed changing, and many of the observations are consistent with model

predictions. However, local knowledge tends to provide greater detail on local conditions and more context on local concerns.

Everyone benefits when we share observations about changes in the weather and the land. We need information from the real climate change experts, the people who are close to the land, as even the most sophisticated computer models still lack good local climate projections. Climate change research will be more effective if guided by local observations and concerns.

Local communities are best positioned to understand and assess their vulnerability to climate change. They are, therefore, best positioned to define what should be done to address the changing conditions at the local level. Community participation in research and decision making is essential to long term resource, environmental and cultural sustainability.

Recommendations

Much work is required to fully prepare for the impacts of climate change. We need to understand more fully the relationship between climate, environmental conditions, and human activities. I would like to propose the following list of recommendations for future work on climate change at the community level in the Yukon.

Document local and traditional knowledge on climate change. Local and traditional knowledge enhances our capacity to understand climate change impacts on northern ecosystems, economies, cultures, traditions and communities. However, since traditional knowledge is open-ended, as are other bodies of scientific knowledge, it is ever-evolving and for the most part still held in the minds and memories of Yukon First Nation elders and storytellers. Conducting oral history research aimed exclusively at climatic and environmental change is likely to produce rich results.

Develop a community-based environmental monitoring strategy. Northern Canada needs to regain its capacity to monitor changing environmental conditions. Over the past decade or so, funding cutbacks has resulted in a substantial decrease in the amount of monitoring taking place. It is extremely important that agencies, organisations and communities in northern Canada work together to develop a strategy to monitor these changes. Currently, a number of efforts have been proposed or are underway to document these changes. A community-based, climate change monitoring strategy is required, to examine ways to coordinate and expand upon existing initiatives in order to make the best use of limited resources, avoid duplication of efforts, and provide communities with support on interpreting and responding to the results of monitoring programs.

Improve community access to information. A northern, climate change information system is needed to share knowledge and information on climate change. This information system should do the following:

- Provide a database of climate change information sources and contacts;
- Provide regular updates when new relevant information is available, and provide some means for non-electronic distribution of information;
- Provide a forum for discussion on current issues and events;
- Record case studies of what communities are doing to respond to impacts of climate change;
- Provide checklists of climate-related considerations for communities, i.e. decision support tools or a resource guide to aid in long-range planning exercises;
- Keep track of information needs, and formalize a system to document and distribute these needs to interested groups;
- List community observations to assist in matching community questions to researchers and to help communities with similar issues to get in touch with each other;
- Provide an opportunity to keep track of questions people have about climate change for which they have not been able to find an answer;
- Include case studies or pilot projects that describe how northern communities are developing or implementing adaptation strategies;
- Include guidance on “what should be done” to respond to climate change;
- Describe what is known about climate change impacts for the various regions as well as for natural and human systems;
- Provide a list of codes, standards and regulatory processes where climate change should be considered; and
- Identify collaborative research opportunities.

The NCE is currently working on a web-based Climate Change Knowledge System for northern Canada that will seek to incorporate the above recommendations.

Fill in information gaps. A recent NSERC/SSHRC task force found that Canadian northern research is in a state of crisis. If action is not taken to improve the situation, northern Canada will be in a very poor position to understand global change, what global change means at local and regional levels, and how to respond to change. A recent project by the NCE identifies gaps in our knowledge base. Products of this work will assist northern communities, researchers, and policy makers in establishing priorities for further research.

Prepare for climate change. Northern communities need to prepare for climate change. Communities should begin to develop strategies to get ready

for changes in climate and environmental conditions, and recognize that the choices made today will influence future vulnerability to climate change. A regional perspective on climate change is needed, and responses to climate change should be developed at the local and regional level. Communities need to assess their vulnerability to change, and develop a regional vision on how to grow and develop into the future, taking climate change into account when managing land, resources and infrastructure. Strategies should be flexible, adaptive (account for trial and error), and responsive to unpredictable events. When developing responses, we need to think not only in terms of the short-term but also the long-term—we need to consider how actions today will affect future generations. Responses to climate change should be prioritized, and the time frame in which each action should be addressed.

The NCE is exploring the possibility of developing a manual to help communities determine the local consequences of climate change, and to facilitate a planning process to incorporate mitigation and adaptation into local decision making and planning exercises.

Develop policy and decision-support tools. Communities need decision-support tools, and higher-level policy decisions to support action on climate change at the local level, not just information. Tools that will enable communities to better understand climate change, reduce their greenhouse gas emissions, and adapt to changing climatic and environmental conditions should be developed. New and existing policies, standards, regulations, legislation, and management agreements will need to become consistent with the goal of reducing both greenhouse gas emissions and our vulnerability to climate change.

The NCE is exploring the possibility of undertaking a strategic planning exercise to determine where linkages and gaps exist in current policies and climate change. Such an exercise could model possibilities and consequences of policy options, and outline where and when climate change considerations should be integrated into planning and decision-making processes. Products of this work could include a tool for local practitioners, consisting of perhaps a computer-based model or an innovative early-warning program that highlights linkages between various programs and policies and climate change.

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Notes

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