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Climate Change Projections for the North Bay-Algonquin Park Region of Ontario

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"Climate has most effect on the natural systems of the landscape. No engineering can shield a forest or cover a watershed. Adapting to change in our terms has largely to do with how we manage our use of natural resources as they react to changing conditions – to temperature and rainfall, fire and insect pests, drought and flooding. Designing and redesigning with nature with as good an eye to the future as uncertain projections will allow, is the only sustainable approach. Adaptive management in the light of ongoing risk assessments means, first and foremost, understanding ecological and hydrological systems as best we can."

Pearson and Burton (2009)

Introduction

There is now broad international scientific agreement that human activities are primarily responsible for recently documented climate change (e.g., IPCC 2007). This has largely been attributed to the release of greenhouse gases (GHGs) into the atmosphere, which have caused warming temperatures, and have changed precipitation regimes and increased extreme weather events. Since the Intergovernmental Panel on Climate Change (IPCC) released its first report in 1990, average global temperature increases of about 0.2°C per decade have been observed, contributing to an average global temperature increase of 0.74°C during the period 1906-2005 (IPCC 2007).

Long-term changes to temperature and precipitation are expected because of climate change. Under low GHG emissions scenarios, the IPCC (2007) predicts a likely global temperature increase of 1.1°C to 2.9°C by 2100. In their worst case GHG emissions scenarios, however, the IPCC (2007) predicts that average global temperatures could increase as much as 6.4°C by 2100. Increases in temperature and the amount of precipitation are most likely to occur in high latitude regions (IPCC 2007). Furthermore, it is almost assured that hot extremes, heat waves, and heavy precipitation events will continue to become more frequent. Importantly, scientific observations are increasingly showing that many impacts of climate change are occurring faster and sooner than projected (Pearson and Burton 2009). In this sense, some current projections of climate change likely represent conservative estimates.

While these trends are expected to continue well into the future, the extent of climate change will largely depend on the level of GHG emissions mitigation around the world. Failure to reduce international GHG emissions will lead to more significant changes and increased risk of impacts. However, even if GHGs were dramatically reduced today, anthropogenic warming and sea level rise would continue for centuries due to the time scales associated with climate processes and feedbacks. For example, the IPCC (2007) has predicted that even with concentrations of all GHGs and aerosols kept at year 2000 levels, a further warming of about 0.1°C per decade is expected. These predictions point to the need for adaptation to climate change as well as for reducing sources of GHG emissions.

Existing climate data for the North Bay-Algonquin Park (NBA) Region of Ontario (Figure 1) have been provided by Gartner Lee (2008). From a climate change perspective, these data are valuable for the climate baseline they provide and for comparing observed climate trends against projected trends. For the NBA Region, Gartner Lee (2008) has provided data on climate stations, average annual precipitation, precipitation distribution, metrological zones, evapotranspiration, and long-term historic temperature and precipitation trends and averages. The type and location of these data within the Gartner Lee (2008) report are described in Table 1.

The objective of this report, which was adapted from Prno and Quinby (2010), is to address climate change projections for the NBA Region including temperature, precipitation and extreme weather events. For this report, we have only utilized the results of other studies, however, regional field data (e.g., Table 1) are useful for conducting region-specific analyses of climate change scenarios. For example, using temperature and precipitation data from the North Bay weather station, OCCIAR (2010) found that annual mean temperature in the NBA Region increased over the period 1938 to 2008, and that total annual precipitation increased by 110 mm during this same time period.

Figure 1 – Core Area of the North Bay-Algonquin Park Region (adapted from Near North Ontario 2017)

Table 1 – Climate Data for the North Bay-Algonquin Park Region

Type of Information	Data Location within the Gartner Lee (2008) Report
Climate stations with average annual precipitation	Section 4.1 and 5.2
Precipitation distribution	Section 4.1, 5.2, and Map 1
Areas for climate stations	Section 4.1
Metrological zones	Section 4.1
Evapotranspiration	Section 4.1 and 5.2, and Map 2
Long term temperature and precipitation trends and averages (historic and projected)	Section 4.1 A preliminary assessment of projected trends is included in this report (see Section 2.2)

Future Climate Change Projections

In Ontario, climate change is expected to impact a variety of climatic conditions. The severity of impacts will differ by location within the province and these changes will be most pronounced along a north-south gradient. For example, it is expected that the northern regions of Ontario will have greater changes in both temperature and precipitation than southern regions (Chiotti and Lavender 2008).

Climate Models

Using global climate models (GCMs), scientists can produce climate change projections for various regions of the earth. An "*ensemble"* approach of running many models together reduces the uncertainty associated with any individual model by minimizing individual model biases. When evaluated using historical empirical data, ensemble results also come closest to replicating historical climate conditions. Although not a guarantee, the results of an ensemble model collection are most likely to represent future climate conditions (CCSN 2009).

The climate projections for the NBA Region discussed below are derived from models developed by 24 international climate modelling centres. These models have been combined by Environment Canada scientists, working as members of the Canadian Climate Change Scenarios Network (CCSN), to compute projections for different regions of Ontario (CCSN 2009). These projections have been based on different assumptions about future volumes of GHG emissions and have been grouped into low, medium, and high scenarios. These models provide a generalized projection of expected changes in each region, but do not provide detailed projections that consider local influences on climate (e.g., effects of local water bodies and changes in relief). However, more locally-focused results can be obtained using a downscaling approach. Other researchers have also presented climate change projections for Ontario (e.g., Colombo et al. 2007, Chiotti and Lavender 2008), but have relied on data from far fewer models.

Using the CCSN model data (CCSN 2009), we have predicted changes in climate for the NBA Region. All CCSN projections used in this report are for the 2050's period. Furthermore, all data are presented as a mean change from 1961-1990 climate averages.

Temperature

In the NBA Region, average annual temperatures are predicted to rise from 2.4°C (under a low emissions scenario) to 3.1°C (under a high emissions scenario) by the 2050's. Winter temperature projections are the most striking, as these expected changes are measurably larger than for other seasons. They are expected to rise 2.7°C (low emissions) to 3.7°C (high emissions) by the 2050's. A detailed summary of the temperature projections for the NBA Region are provided in Table 2.

Table 2 - Projected increases in mean temperature (°C) for the North Bay-Algonquin Park Region in the 2050s compared with 1961-1990, using low, medium, and high emissions scenarios (data from CCSN 2009)

	Low Emissions	**Medium Emissions**	**High Emissions**
Annual Temperature	2.4	2.8	3.1
Winter Temperature	2.7	3.3	3.7
Spring Temperature	2.3	2.6	2.9
Summer Temperature	2.2	2.6	2.9
Autumn Temperature	2.3	2.6	2.8

Precipitation

Model projections for total precipitation in the 2050's indicate that a change in annual average precipitation of 5.7% (low emissions) to 6.3% (high emissions) is expected. The greatest seasonal increase in precipitation is predicted to occur in the winter with increases of 10.5% (low emissions) to 12.2% (high emissions) projected. Relatively large precipitation increases are also projected for the NBA Region during the spring season, with increases of 9.7% (low emissions) to 10.5% (high emissions). Changes in summer and autumn precipitation are much smaller by comparison. A detailed summary of the precipitation projections for the NBA Region are provided in Table 3.

Extreme Weather Events

As climate changes, it is also widely expected that the frequency of extreme weather events such as floods, severe storms, and other high magnitude precipitation events will increase in Ontario (Pearson and Burton 2009) as well as throughout the rest of the world (IPCC 2007). In the NBA Region, it appears that a shift in the causes and timing of flooding events has recently occurred. Historically, the majority of flooding was associated with spring snowmelt runoff, however, more recently between 1990 and 2003, only 34% of floods have occurred in the spring (March and April). The other 66% of floods have occurred throughout the remainder of the year because of heavy rainfall, rain-on-snow conditions, and ice jamming (Chiotti and Lavender 2008).

Table 3 - Projected increases in mean precipitation (%) for the North Bay-Algonquin Park Region in the 2050s compared with 1961-1990, using low, medium, and high emissions scenarios (data from CCSN 2009)

	Low Emissions	Medium Emissions	High Emissions
Annual Precipitation	5.7	6.2	6.3
Winter Precipitation	10.5	11.6	12.2
Spring Precipitation	9.7	10.2	10.5
Summer Precipitation	1.2	0.6	0.2
Autumn Precipitation	4.0	4.8	5.0

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