An Overview of Canada's Changing Climate: An Ontario perspective

Ontario Centre for Climate Impacts and Adaptation Resources (OCCIAR) 2015

Observed Temperature and Precipitation Changes

Overwhelming evidence from recent studies has demonstrated that the global climate is warming and changing in other ways, although decadal-scale fluctuations are still occurring. In Canada, the annual average surface air temperature has increased by 1.5°C over the period of 1950-2010 (Bush et al., 2014). Although the strongest trends have been observed in the north and west of Canada, warming has been observed consistently across all of Canada, including Ontario (Figure 1) (Vincent et al., 2012).

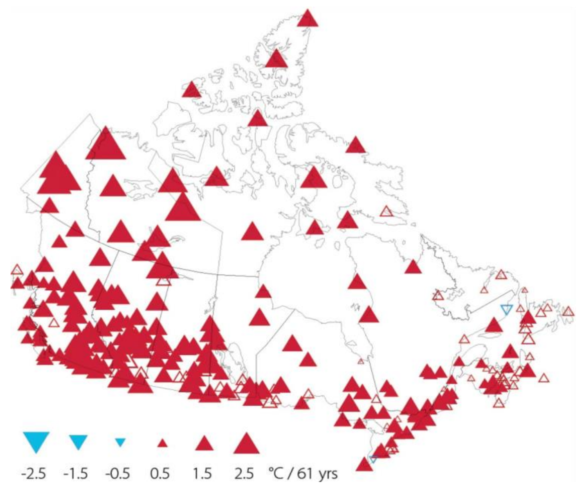

Figure 1: Trends in annual mean temperature from 1950-2010 (Vincent et al., 2012; in Bush et al., 2014).

Daily precipitation data demonstrate that Canada has generally become wetter in recent decades – an increase in average annual precipitation of approximately 16 percent over the period of 1950-2010 (Bush et al., 2014). In Ontario, the southern region has experienced increases in precipitation, however lack of monitoring stations in the north make it more difficult to detect strong precipitation trends (Figure 2).The change in temperature has also impacted the type of precipitation. Several regions of southern Canada, including parts of Ontario, have experienced a decrease in snowfall and an increase in rainfall (Mekis and Vincent, 2011a).

Changes in the frequency and intensity of extreme weather events have been observed in the Northern Hemisphere. Increases in the frequency of warm days during the summer (when daily maximum temperature is above the 90th percentile) have been recorded across Canada (Bush et al., 2014). Warmer air can absorb and hold more moisture through evaporation, making more intense precipitation events possible (Held and Soden, 2006; Trenberth, 2011). This relationship has been verified by an observable trend of increased extreme precipitation events over most of the Northern Hemisphere, but a consistent pattern has not yet emerged over Ontario (Min et al., 2011).

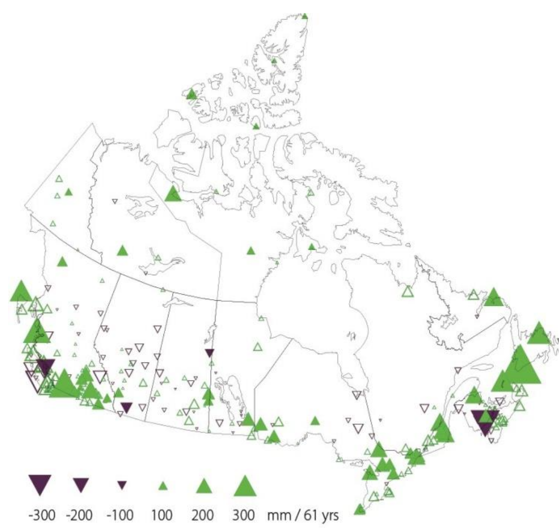

Figure 2: Annual total precipitation trends from 1950-2010 (Mekis and Vincent, 2011b; in Bush et al., 2014).

Projected Temperature and Precipitation Changes

Based on the results from an ensemble of climate models, average summer temperatures are expected to increase by approximately 1.5 - 2.5°C in Canada by the middle of the century under a low greenhouse gas emissions scenario. Greater warming is expected in other seasons, by approximately 3 - 7°C in southern Ontario and >9°C around Hudson Bay during the winter season toward the end of the century under a medium-high emissions scenario (see Figure 3) (IPCC, 2007; Bush et al., 2014).

Projections indicate an expected increase in seasonal precipitation across the majority of Canada and especially the north, with the exception of summer and fall when there is a decrease in precipitation at mid-latitudes affecting much of southern Canada including the Great Lakes region (Figure 3) (Bush et al., 2014). Recent studies have also indicated the likelihood of more frequent and intense extreme precipitation events across all regions. By the 2050s, a one-in-20-year return period storm is likely to become a one-in-10-year storm (Kharin et al., 2007).

Other projected climate change impacts in Ontario are more region-specific. Freshwater ice cover break-up dates are expected to occur 1 to 3½ weeks earlier by mid-century, while freeze-up dates are expected to be delayed by up to 2 weeks (Dibike et al., 2012). However, this will vary due to regional climate influences as well as depth of the freshwater body (Bush et al., 2014). In Ontario, ice cover on the Great Lakes is influenced by atmospheric and oceanic circulation patterns including the Pacific Decadal Oscillation and the North Atlantic Oscillation. The influence of these patterns increases variability in many climate parameters, including freshwater ice cover (Brown and Duguay, 2010). A decrease in ice cover on freshwater lakes can have implications for their role in energy production, water availability, ecosystem changes and transportation (through ice or winter roads). Variability in the extent of ice cover could make it difficult to adapt to these impacts (Bush et al., 2014).

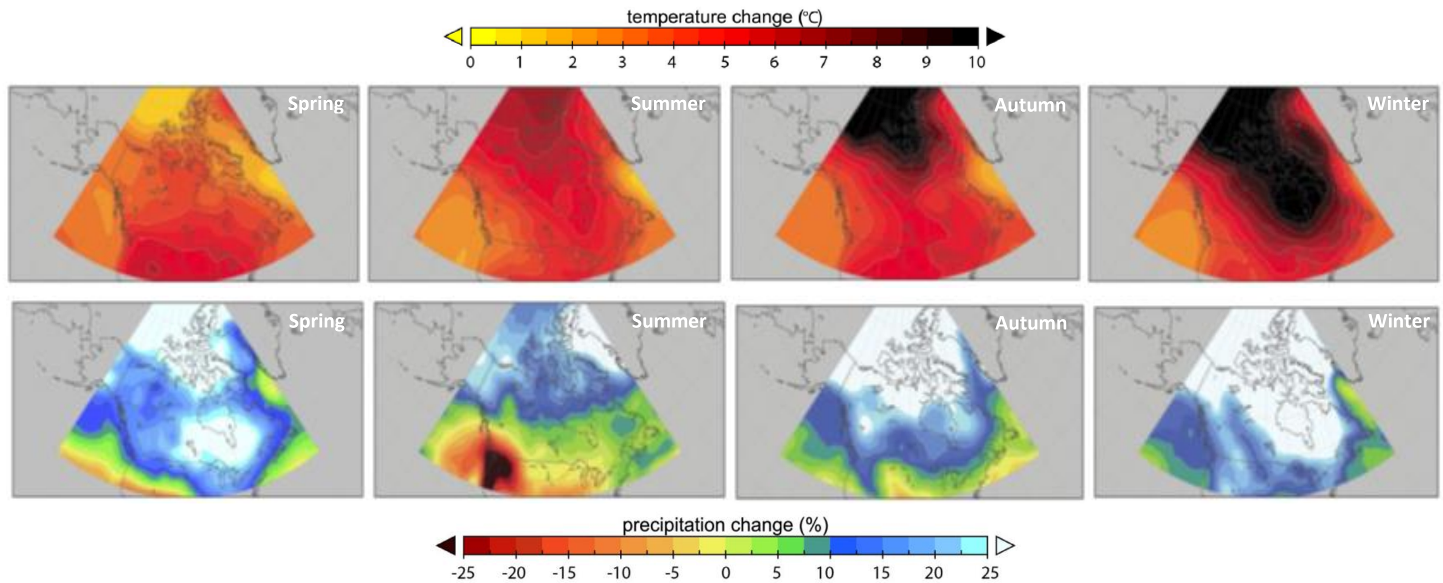

Figure 3: Projected seasonal changes in temperature and precipitation across Canada in the 2080s relative to 1961-1990 using a high emission scenario (A2) (Bush et al., 2014).

Changes in freshwater availability are similarly region-specific. In Ontario, studies on Great Lakes water levels have revealed that although most climate models project a decline in Great Lakes water levels under a range of scenarios, high water levels are also a possibility under select scenarios (Angel and Kunkel, 2010; IUGLS, 2012). Several studies have been completed on climate change and water levels in other Ontario watersheds. The projections resulting from these studies are mixed and do not appear to follow the projections for the Great Lakes (Bush et al., 2014).

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The information presented is based on Chapter 2 of NRCan's 2014 National Climate Assessment titled **Canada in a Changing Climate: Sector Perspectives on Impacts and Adaptation** with additional Ontario-specific information. For more information on the National Assessment, please visit: www.nrcan.gc.ca/environment/resources/publications/10766

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