Summary for Sierra Club Canada on the U.S. National Climate Assessment Report and its implications for Canada

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July 28, 2014

1.0 Objective

The goal is to summarize the recently released U.S. Third National Climate Assessment Report (hereafter referred to as NCA) and analyze the implications of this report for climate change in Canada. The NCA is a 2014 update to the previous NCA report "Global Climate Change Impacts in the United States" released in 2009 and is available at http://nca2014.globalchange.gov. Additionally, we compare the NCA report with the recently updated Natural Resources Canada (NRCAN) report, "Canada in a Changing Climate: Sector Perspectives on Impacts and Adaptation" in section 7.0.

2.0 Background and Overview

The NCA is a report produced by the Government of the United States of America (hereafter referred to as the US Gov't) that assesses the impacts of climate change on the United States. It was produced over several years by a team of more than 300 experts, drawing on a large volume of scientific peer-reviewed research. The impacts of climate change are examined both by sector and by region. In addition, there is a chapter on response strategies including research needs and there is a significant amount of supplementary information contained in the appendices including the Report Development Process (A1), Information Quality Assurance Process (A2), Climate Science Supplement (A3), FAQ (A4), Scenarios and Models (A5) and Future Assessments (A6). For example, some of the answers to commonly asked questions about climate change are contained in the FAQ section (A4).

The section on our changing climate summarizes the current state of knowledge on climate change. The warming over the last 50 years is primarily due to human activities and this rate of warming is expected to increase in the coming decades. US temperatures have increased, the length of the frost free season has increased, average US precipitation has increased, and extreme weather events such as heat waves, floods, droughts, hurricanes, winter storms, etc. have increased whereas cold waves have decreased. Global sea level has increased and ice and snow extent have decreased. Finally the oceans are absorbing 25% of the CO2 emitted to the atmosphere and are becoming more acidic as a result, causing a disruption to marine ecosystems. For more detailed and extensive information on the present state of knowledge on the climate system we refer the reader to the Intergovernmental Panel on Climate Change (IPCC) Assessment Report 5 (AR5) Working Groups (WGI, WGII and WGIII).

3.0 Summary by Sectors

3.1 Human health

The warming climate threatens human health due to impacts from extreme weather events, such as heat waves, droughts, flooding and wildfires. There is also an increase in episodes of poor air quality and increased transport of allergens such as pollens causing respiratory distress and an increase in illnesses that are carried by mosquitoes and ticks (e.g. Malaria and Lyme disease). There are certain demographics of people (e.g. elderly, very young, low income) and communities that are disproportionately impacted by a warming climate. It is important that public health officials at all levels of government (federal, state or provincial, and municipal) stress the need for early preparedness and prevention to protect people from some of the impacts under a warming climate.

3.2 Water resources

There has been an increase in extreme precipitation events in all regions and increases in annual precipitation and river-flow recently observed in the Midwest and Northeast. However, the length of dry spells will increase, especially in the Southern and Northwestern regions. The Southwest is becoming increasingly susceptible to extensive and long-term mega-droughts while shorter-term droughts may increase in other regions, even where there are increases in frequency, intensity and duration of extreme precipitation events. The warming climate impacts water supplies, reducing groundwater, reservoir, lake and river levels in some areas and causing river and overland flooding in other areas. In addition, an increase in sea level rise and storm surges can impact the sustainability and quality of coastal freshwater sources such as aquifers and wetlands.

3.3 Energy production and use

Extreme weather events are negatively affecting the energy infrastructure and the production and delivery of energy, therefore causing energy supply issues. A good example of this is the rolling blackouts in California whenever there is an intense and widespread heat wave. Recent ice storms and tropical storms have damaged energy infrastructure in many regions of the US. Increasing frequency, intensity and duration of heat waves will cause an increase in summer power demand but warmer winters may decrease demand, however there is a net annual increase in demand. Water supply issues will affect hydro-electric production depending on the region, and water temperature rises can exceed safety levels for nuclear power plant cooling requiring reactor shutdowns and lengthy and expensive restarts. Sea level rise, storm surge and hurricanes will affect offshore energy production. A warming climate will change the overall future energy mix creating both risks and opportunities. As fossil fuels are phased out we will move towards much more renewable energy but extreme weather and climate change will affect some of these energy sources, both negatively and positively.

3.4 Transportation

Extreme weather events, sea level rise, heat waves, flooding and Arctic warming are negatively affecting the reliability and capacity of the U.S. transportation system. Sea level rise and storm surge are having major impacts on coastal transportation infrastructure (e.g. flooding of airports, ports and harbours, roads, rail lines, tunnels and bridges). The transportation infrastructure is not only important economically, but it serves as a mode of evacuation when climate disaster strikes. Under climate warming transportation disruptions will continue to increase. The costs of these disruptions will be high but impacts can be reduced through rerouting and more sustainable modes of transportation.

3.5 Agriculture

There will be a negative impact on agricultural production within the next few decades. Most agricultural regions will experience declines in crop and livestock production due to climate warming induced stresses such as weeds, insects, diseases and lack of

water. Increasing precipitation extremes and longer periods of droughts will make agriculture less viable in the next few decades. It is possible that agriculture will not be able to adapt to rapid changes in climate over the next few decades. This rapid change in climate has serious consequences for food security (due to low crop yields and high prices due to food processing, storage, transportation and distribution) both in the US and globally. These negative impacts far outweigh any positive impacts due to increased plant fertilization from higher atmospheric CO_2 concentrations and warmer temperatures with longer growing seasons.

3.6 Forests

A warming climate (and especially warmer and drier winters) is increasing the vulnerability of forests to wildfires, insect infestations, drought and disease outbreaks. Forests in the US store about 16% of all CO_2 emitted by fossil fuel burning in the US per year, therefore a reduction in forests reduces the rate of CO_2 uptake. Bioenergy could emerge as a new market for wood from forests that have to be cut down due to drought or insect infestations. Forest management becomes more challenging under a warming climate.

3.7 Ecosystems and biodiversity

A warming climate negatively impacts ecosystem ability to improve water quality and regulate water flows. The rate of warming is overwhelming the capacity of ecosystems to handle the impacts of extreme events such as wildfires, floods and storms. The rate of species extinction is accelerating and some species are not able to shift their range poleward to cooler regions due to the rapid nature of climate change. The timing of animal migrations, spring flowering and other biological cycles has shifted leading to impacts such as frost kills. For example, the March 2012 heat wave caused early blooming of apple trees in the Great Lakes that were subsequently killed off by an April frost. The management of the whole ecosystem may be a much better approach than simply focusing on single species.

3.8 Multiple sectors

There are six chapters that address how climate change interacts with multiple sectors. These sectors overlap with the previous single sector assessments therefore will be covered only very briefly here:

1. Energy, water and land use

   There is a strong dependence of energy systems on land availability and water supplies which creates risks, vulnerabilities, but also opportunities for reducing greenhouse gas emissions. Renewable energy sources are undergoing enormous growth rates but still lack the generous subsidies of fossil fuel extraction.
2. Urban infrastructure and vulnerability

   The infrastructure requires upgrades and maintenance and needs to be more resilient to the impacts of extreme weather and climate change. Often climate-related disruptions in one infrastructure system will cause disruptions in one or more infrastructure systems, a so-called cascading effect. Adapting urban infrastructure to

a more extreme climate requires a coordinated effort among city/state/federal government agencies, non-governmental organizations and the private sector.

3. Indigenous peoples, lands and resources

Climate change will disproportionately impact native peoples' livelihoods due to water related challenges, access to traditional foods and relocation of settlements. In Alaska, thawing permafrost, increasing temperatures and declining sea ice is creating more dangerous travel and hunting conditions, damage to settlements and infrastructure, food insecurity and significant socioeconomic and health impacts due to loss of traditional knowledge and cultures.

4. Land use and land cover

Land-use and land-cover changes will strongly affect local, regional and global climate processes. These land use choices will impact how vulnerable or resilient communities and ecosystems are to climate change. Land use choices may help reduce greenhouse gas levels in the atmosphere and increase of albedo can reduce local and/or regional warming. Cities can reduce the impacts of the urban heat island effect through innovative measures such as rooftop greening, conversion of asphalt to gravel surfaces and tree planting initiatives.

5. Rural communities

Climate change is negatively impacting rural communities and will shift the locations where rural economic activities can continue. There are issues of physical isolation, limited economic diversity, higher poverty rates and aging population that increase the vulnerability of rural communities to climate change. Extreme changes in temperature and precipitation are extremely challenging for agriculture and livestock operations. A significant amount of adaptation to climate change is needed in rural communities.

6. Biogeochemical cycles

Human activities have more than doubled the amount of nitrogen available to ecosystems and increased phosphorus and other elements. Altered biogeochemical cycles due to rapid climate change will have many impacts on ecosystems and human health.

4.0 Summary by Regions

4.1 Northeast

The main impacts are an increased frequency and intensity of heat waves, more extreme precipitation events and increased probability of coastal flooding due to sea level rise and storm surges. This is evident with some recent events such as Hurricane Sandy (2012) and Tropical Storm Irene (2011), which caused extensive damage to infrastructure in New York (state and city) and Vermont.

4.2 Southeast and Caribbean

There is decreased availability of water due to warmer temperatures, land use change and population growth. In addition, there are increased risks with extreme events such as hurricanes and flooding. With sea level rise, the storm surge from even low-end category hurricanes are enough to cause severe damage to coastal regions.

4.3 Midwest

The main impacts are an increased frequency and intensity of heat waves, droughts and flooding. For example, the Mississippi River went from extreme flood stage in 2011 to extreme drought stage in 2012 where the channel depth had to be increased by blasting so that barges could still pass through. As of early July 2014, there is major flooding in the Upper Mississippi basin with several gauges recording crests 10-15 feet above flood stage. The extreme swings from flood-to-drought-to-flood are causing enormous challenges to infrastructure and transportation.

4.4.Great Plains

The main impacts are an increased frequency and intensity of heat waves and droughts but there can also be flooding, especially in Northern regions. These extreme events have a significant negative impact on agricultural practices and output. The major heat wave and drought during the summer of 2012 covered a large aerial extent of the Great Plains and caused a significant reduction in agricultural yields and thus large increases in food and biofuel prices

4.5 Southwest

Increased numbers and durations of droughts and increased warming is causing a shortage of water supplies for people and ecosystems along with a greater threat of wildfires. As of early July 2014, the entire state of California is in one of the four most severe categories of drought (categories of D2, D3, D4 or D5). In fact, most of the state is in the latter 3 categories which are the most severe. In addition, reservoirs such as Lake Mead, which supplies water for Las Vegas and agriculture, are reaching record low levels in mid-2014, levels not seen since the reservoir was filled in 1937.

4.6 Northwest

There are major changes in the summer supply of water due to warming temperatures, more unpredictable winter precipitation with more rain and less snow, and earlier snowmelt. The more variable precipitation both spatially and temporally is causing changes in the timing of stream flow that impacts communities and ecosystems. In addition winter storms can cause major flooding and landslides isolating mountain and coastal communities.

4.7 Alaska and the Arctic

There is a much higher rate of warming in the Arctic region when compared to the mid-latitudes which is causing a rapid decrease in summer sea ice extent, a decrease in the extent of glaciers and thawing/thinning permafrost causing extensive damage to northern infrastructure and major ecosystem changes. In January of 2014, warm temperature and rain caused a major landslide that blocked the main highway into Valdez, Alaska. In addition, there are significant impacts on Alaskan Native communities.

4.8 Hawaii and US Pacific Islands

There are significant fresh water supply decreases due to increased temperatures causing water and food security issues. There have been some events such as flooding and hurricanes in/near Hawaii that are becoming more frequent.

4.9 Coastal regions and Oceans

Coastal communities are becoming increasingly vulnerable to rising sea levels, heavy storm surges, inland flooding, landslides and other climate-related extremes. There is increased ocean acidification resulting from the rapid increase in CO_2. This and the very

strong increase in heat content in the oceans results in a severe disruption to marine ecosystems.

5.0 Summary of Response Strategies

This chapter covers decision support, mitigation, adaptation, research needs and sustained assessment. Decision support is important because decisions need to be based on the best available evidence (i.e. scientific information) and better decisions can reduce the risk and protect people, property and ecosystems from the impacts of a warming climate. Mitigation is important as the amount of reduction in GHGs will determine how much adaptation to the changing climate is required. The section on research needs and sustained assessment stress that we need updates and improved assessments in the future with ongoing assessment activity.

6.0 Implications of the NCA for Canada

In terms of the regions assessed in the NCA report being transferable to similar regions in Canada, the following statements can be made: the Alaska and the Arctic sections are applicable to the Yukon and the Canadian Arctic, the Northwest region is applicable to Southern British Columbia, the Great Plains is applicable to the Southern Prairies, the Midwest is applicable to the Great Lakes region and the Northeast region is applicable to Southeastern Canada. The climate projections for the regions in the NCA report can be extended into the corresponding regions of Canada. In addition, a number of the maps in the NCA report give data coverage for all of North America and therefore are directly applicable to Canada. For example, Figure 16.2 on p.374 has a map of the projected increases in the number of days over 90ºF for the Northeast USA. This map could easily be extended into Southeastern Ontario, Southern Quebec and New Brunswick. Some maps even show data for all of North America and are thus directly applicable to Canada.

7.0 Comparison with report by NRCAN

Natural Resources Canada, a department of the Government of Canada has updated their 2008 Report, “From Impacts to Adaptation: Canada in a Changing Climate 2007.” The title of the 2014 update is (hereafter referred to NRCAN): “Canada in a Changing Climate: Sector Perspectives on Impacts and Adaptation.” The main difference between these two reports is the 2014 report is organized by sector whereas the 2008 report is organized by region. It is somewhat confusing in the sense that the 2014 report by sector is an update to the 2008 report by regions.

There are some statements about climate change that are questionable in the NRCAN report given the new information we have about the climate system and recent changes in the system. For example, on page 9 of the NRCAN report it states, “A nearly ice-free summer is considered a strong possibility for the Arctic Ocean by the middle of the century.” This statement was likely taken from the 2007 IPCC AR4 climate report; however, with the exponential decline in sea ice volume (using the PIOMAS model) and supported by recent CryoSat satellite measurements on sea ice

thickness, we can expect a complete loss of summer sea ice in the Arctic before the end of this decade, possibly as early or before 2018.

The NCA report was found to be significantly more comprehensive and extensive as compared to the NRCAN report in a sense that it covers sectors (both single and multi-sector), regions and response strategies. In the NCA report there also appears to be a very strong interdisciplinary effort between multiple government departments and agencies, which is not clearly evident in the Canadian report as it was only produced by NRCAN, although some experts from Ouranos, Environment Canada and other organizations were consulted. The NCA report also received extensive coverage in the media (both traditional and social media). In fact, there was a live web-stream from the White House with the science advisor to the president and others presenting both on the findings and implications of the report. In contrast, the NRCAN report was released with minimal fanfare and exposure during a media slow period.

We find that a comprehensive climate report similar in format and structure to the NCA report is urgently needed in Canada and it is essential that this report should involve multiple government departments and agencies (e.g. Environment Canada, Department of Fisheries and Oceans, NRCAN, Public Safety, Public Health, Transportation, StatsCan, etc.) along with NGOs such as the Pacific Climate Impacts Consortium (PCIC), the Canadian Climate Forum and others. The report will need to focus in detail on how regions and sectors should adapt to a climate that is dramatically changing now. In addition to the national report, major cities and municipalities require a detailed climate change adaptation plan that includes elevation studies to examine where water will collect when torrential rain events occur (e.g. Calgary 2013 and Toronto 2013). The City of Ottawa has recently released their climate change plan which considers river flooding but neglects to examine impacts of widespread extreme rainfall events and associated flooding.

The sense of urgency for action on adapting to rapid climate change should be emphasized along with a detailed plan of action. It is not a matter of decades but a matter of now, within this decade. In closing, we have a few more years to adapt but the focus will need to shift to climate change resilience and management of these climate disasters. How can communities, regions, sectors and people in Canada better prepare and protect themselves against climate disasters that are rapidly becoming the new climate normal? (e.g. a 1 in 1000 year flood can happen every decade)

References

City of Ottawa, 2014. Air Quality and Climate Change Management Plan. Available at http://documents.ottawa.ca/en/document/air-quality-and-climate-change-management-plan

IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp.

IPCC, 2014: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
IPCC, 2014: Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Melillo, Jerry M., Terese (T.C.) Richmond, and Gary W. Yohe, Eds., 2014: Climate Change Impacts in the United States: The Third National Climate Assessment. U.S. Global Change Research Program, 841 pp. doi:10.7930/J0Z31WJ2.

Warren, F.J. and Lemmen, D.S., editors (2014): Canada in a Changing Climate: Sector Perspectives on Impacts and Adaptation; Government of Canada, Ottawa, ON, 286 pp.

Lemmen, D.S., Warren, F.J. Lacroix, J., and Bush, E., editors (2008): From Impacts to Adaptation: Canada in a Changing Climate 2007; Government of Canada, Ottawa, ON, 448 pp.