FAQ's: Climate Change Projections, July 2018

Q1. Who developed the projections for the Government of Newfoundland and Labrador?
The projections were developed by Memorial University climatologists with funding provided by the provincial government. The principal lead researcher is Dr. Joel Finnis, Associate Professor of Geography at Memorial University. Dr. Finnis holds a PhD in Atmospheric and Oceanic Sciences from the University of Colorado. His research involves the analysis and inter-comparison of large climate data sets, climate analysis and forecasting, and studying climate dynamics in Arctic and Sub-Arctic regions. Dr. Finnis is a leading expert in Canada for the downscaling of global projection models for application to smaller regions, such as Newfoundland and Labrador. The methodological approach used by Dr. Finnis was peer reviewed by other climatologists and academics in Canada.

Q2. Can you provide some detail on the process by which global climate projections models are "downscaled"? What exactly is "downscaling"?
Global climate models generally provide long-term climate projections on grids as large as 1,000 x 1,000 kilometres. Within North America, a regional research project led by climate experts, academics institutions and research organizations has "downscaled" global climate models for Canada, the US and northern Mexico to grids as small as 25x25 kilometres. These downscaled models have also formed the basis for work in other provinces. Dr. Finnis utilized an ensemble approach that included six statistical downscaling simulations and six dynamic downscaling simulations. This process reduces the level of uncertainty in the projections.

Q3. What has changed since the release of the 2013 Climate Change Projections?
A previous set of projections were developed in 2013 based on the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (2007) These projections, which compared the end of the 20th century to the mid-21st century, were also developed by Dr. Finnis. The revised projections are based on the fifth report of the Intergovernmental Panel on Climate Change (2014), include projections for both the mid-21st century and late 21st century, include additional locations within the province, and include smaller grids where available.

Q4. The climate projections forecast change from the end of the last century to the latter part of this century. Can you be more specific on the data underpinning the projections?
The climate models used by Dr. Finnis examine changes in key temperature and precipitation climate variables for 29 locations from a 30-year period at the end of the 20th century to the mid-(2041-2070) and late 21st century (2071-2100). Extreme precipitation projections (i.e., projected precipitation for major storm events) are available for 19 of these locations. Climate variables such as wind are not included in the study. Data underpinning the work is maintained by Environment and Climate Change Canada. Historical weather data is publicly available.

Q5. The study includes projections at 25x25 km grids, however some regions of the province that do not have a weather station. How are these included?
The regional climate models project climate at 25x25 km grids, or where unavailable 50x50 km grids. Climate modeling techniques interpolate projections between the locations for which data is available.

Q6. The projections include 19 climate variables. Can you be more specific about what these variables are?
The projections examine changes in average, average maximum and average minimum daily temperatures for each season. It also measures change in technical measures such as heating and cooling degree days, which are important to energy providers, and growing degree days,

which are important to industries such as forestry and agriculture. Measures such as the duration of heat waves and the number of frost days are also analyzed. For precipitation, the projections look at changes in the frequency of precipitation events, the amount of precipitation levels per precipitation event, the frequency of more intense precipitation events, and the average and maximum dry spells. A full list of the variables projected by Dr. Finnis is included in the technical report, available online.

Q7. What is a heating, cooling and growing degree day?
A heating degree day is a technical concept to measure the potential demand for energy to heat a building, for example, providing an indication of how much heat a building may need. It sums up the temperature difference between the average daily temperature and 16ºC, for days in which the average temperature is less than 16ºC. For example, if today's average daily temperature were 10ºC, there would be 6 heating degree days calculated for today. Conversely, a cooling degree day is a measure of the potential demand for space cooling, providing an indication of much cooling a building may need. It sums up the temperature difference between the average daily temperature and 16ºC, for days in which the average temperature is higher than 16ºC. A growing degree day is a measure of warmth in soils and waters, and can be used to determine changes in resource productivity. It sums up the temperature difference between the average daily temperature and 10ºC, for days in which the average temperature is higher than 10ºC.

Q8. The study is limited to temperature change and precipitation. Why are there no projections for wind or fog?
Global climate models focus on temperature and precipitation. Other variables, such as wind and fog, are not as well developed in global models, are more localized in nature and do not have as reliable historical weather records.

Q9. The climate is constantly changing. When can these projections be updated?
The study used the most recent global models, modeling techniques and data available. It is not anticipated that the study will be revised until after the next report from the Intergovernmental Panel on Climate Change. This report is expected to be released before 2023.

Q10. Will temperatures rise in a straight line between now and the middle of the century, or will there be peaks and valleys along the way?
The models do not make yearly or decadal projections; rather they make long-term, tri-decade (30 year) projections. Historical records suggest that global temperature warming will not be uniform on a year over year basis, but will move in a generally uniform pattern over the longer term.

Q11. Will we see more hurricanes and tropical storms?
This province has been experiencing, on average, over 11 hurricanes and post-hurricane tropical storms per decade since 1990, compared with about six storms per decade prior to 1990. While models do not project the frequency of hurricanes, projections indicate that there will be more and more intense storms by mid- and late 21st century.

Q12. What about precipitation rates, will we experience more rain in the province due to climate change?
The new projections show that the number of days with precipitation will be relatively stable going forward, however the precipitation events themselves will intensify. Across the province

as a whole, average extreme precipitation during major storms is expected to increase 23 percent by mid-century, and 37 percent by late century. This could lead to an increase in flooding, sea surge, coastal erosion and infrastructure damage.

Q13. It appears as though temperatures are rising in the province faster than they are at a global level. Are temperatures warming faster locally than globally?
Global temperature change cannot be compared to temperature change at any specific location. Average global temperatures are measured at several hundred stations across the world, including land-based and ocean-based locations, and locations in the northern and southern hemispheres. However, the direction of change locally is the same as global trends.

Q14. Carbon dioxide concentrations in the atmosphere are at their highest level in human history. Do these projections include anticipated further growth in carbon dioxide concentration?
Carbon dioxide concentrations are now at approximately 400 parts per million. By comparison, they ranged between 200 and 300 parts per million prior to the Industrial Age. Global climate models assume increasing carbon dioxide concentration.

Q15. Data shows that temperatures are rising in Newfoundland and Labrador. However, temperatures in the spring and summer months do not appear to be different than in the past. How can you say that the climate in the province is warming given these examples?
Average annual temperatures in the province are now about 1ºC above the average from 1970 to 2000, and have been at least 1ºC higher since the mid-1990s. In fact, up to 2017, three of the five warmest years since World War II have occurred in this century, including four of the warmest five summer seasons and four of the warmest five fall seasons. However, it is difficult to associate any short-term weather pattern with long-term climate change.

Q16. Will some areas of the province be relatively more impacted than others?
Different regions of the province may be impacted by climate change in different ways. Some locations are projected to warm more than others, and some areas are projected to see more rapid growth in precipitation intensity. For example, Labrador is expected to be impacted differently than Newfoundland, and winter temperature change is expected to be different than in the summer months. However, all regions of the province are projected to experience warming, more precipitation and more intense weather events.

Q17. Can we expect to see more invasive species, like coyotes, as the result of climate change?
Climate change impacts are seen gradually over decades, not years. While the natural range of any species is often heavily influenced by environmental conditions, including precipitation and temperature, other factors such as changing land use patterns and unintended movements linked to freight transportation (e.g., insects can unintentionally be transported on ships) can also impact species range. Going forward, climate change could continue to result in change in species range, however, we cannot predict with any certainty when and how this will occur.

Q18. With increasing temperatures, will Newfoundland and Labrador see an increase in tick bites and Lyme disease?
Lyme disease is a bacterial infection transmitted to humans by a bite from an infected black-legged tick. Ticks are commonly found in eastern and central Canada as well as the United States and are most active in the spring, summer and fall in warmer climates. Infected ticks have been found throughout the province. To date, the total number of cases of Lyme disease diagnosed in the province has been very small, and the risk of infection is low. However,

scientists indicate that a warming climate could lead to increased incidence of Lyme disease in the province in the future; however, further research is needed.

Q19. Can you give us some examples of how different organizations and individuals can use this information?

The projections can be used for a range of economic development, infrastructure and municipal planning processes. For example, warmer temperatures may lengthen agricultural seasons or facilitate the introduction of new crops; increased precipitation projections may lead to change in the location and size of bridges, culverts and other infrastructure; and planners may use precipitation projections to understand the risk of overland flooding and coastal erosion.

Q20. How will you ensure that this information is made available to stakeholders throughout the province?

All temperature and precipitation projections are posted on www.turnbackthetide.ca as well as the Department of Municipal Affairs and Environment's website. The provincial government is working with other departments, industry associations, non-governmental organizations and municipalities to maximize dissemination and utilization of the information.