

FACT SHEET

# Climate Change and Storms

April 2025

Climate change is increasing the intensity of extreme weather across the globe—including storms. Warmer global temperatures provide more energy to fuel storms, making them more powerful and less predictable. As a result, storm-related hazards such as hail, damaging winds, and flash floods are becoming more frequent and severe in many parts of Canada. Ongoing scientific research continues to clarify the links between human-caused climate change and the intensification of storms (Smith & Malena-Chan 2024).

Projecting the future effects of climate change on storms in Canada is challenging due to their complex, localized nature. In Canada, changes to the factors that drive storms can differ significantly by region and the smaller scale and short duration of many convective storms make them difficult to model accurately with global climate models. While warming is expected to increase the frequency and intensity of convective storms in Canada, the exact timing, location, and severity remain uncertain. [More research specific to Canada is needed](#) to improve projections and better understand local variations (Smith & Malena-Chan 2024).

## Climate change is making storms stronger and more frequent

- Convective storms—including thunderstorms, hailstorms, tornados and hurricanes—occur when warm and moist air rises in the atmosphere. As the atmosphere warms with climate change, it can hold [more moisture](#) (NASA 2022).
- Over land, warming surface temperatures make moist air rise more quickly, providing [more fuel for severe thunderstorms](#) (Smith & Malena-Chan 2024). Similarly, rising ocean temperatures due to global warming allow surface water to evaporate and rise more quickly, fuelling [more powerful and intense hurricanes](#) (Madge & Smith 2024).
- Favourable conditions for the development of severe convective storms are expected to increase by [5 to 20 per cent for each degree °C](#) of global warming (Lepore et. al 2021).

### **Storms are racking up damages in parts of Canada**

- Storm hazards—such as strong winds, hail, and lightning—pose [serious risks](#) to infrastructure, agriculture, and communities and are a major driver of catastrophic losses in Canada (Ouranos, n.d.).
- Large hail is one of the most costly severe storm-related hazards in North America, with annual insured losses routinely exceeding [\\$10 billion across the continent](#) (Loomis 2018).
- In August 2024, a hailstorm in Calgary became the second costliest extreme weather event in Canadian history, with over [\\$3.2 billion](#) in insured losses (IBC 2025).
- Straightline winds—winds that blow in a straight path, usually from thunderstorms or severe weather systems—are one type of extreme weather growing more frequent and destructive due to climate change (Prein 2023). Between 2008 and 2021, roughly two thirds of [catastrophic insured losses in Ontario and Quebec](#) were caused by windstorms (Hadavi et. al, 2022).
- The 2022 Derecho—a powerful, fast-moving line of wind and thunderstorms—caused about [\\$1 billion in insured losses](#) across Ontario and Quebec (IBC 2023).

### **Many regions of Canada will likely experience more frequent and severe storms as climate change accelerates**

- Climate models project more severe thunderstorms and [heavy rainfall](#) in Canada, particularly in the [Prairies](#) and [eastern](#) regions (Kirchmeier-Young & Zhang 2020; Loxley 2022; Ouranos, n.d.).
- In [southern Quebec](#), rising temperatures are expected to increase atmospheric instability, leading to more thunderstorms and more frequent short bursts of intense rainfall (Ouranos, n.d.). In [central Alberta](#), climate modelling also projects increased storm intensity in the coming decades (Gan et. al, 2022).
- In Atlantic Canada, climate change is making [hurricanes](#) more frequent and more powerful (Madge & Smith 2024).
- On the Pacific coast, climate change is increasing the intensity and frequency of [atmospheric rivers](#) that bring extreme rainfall, increasing the likelihood of events, like the one which brought severe flooding and landslides to B.C. in 2021, by 45 to 60 per cent (Gillett et. al 2022).

### **Climate change is altering patterns of damaging winds, tornadoes, and hail**

- While atmospheric warming will likely alter the frequency, severity, and areas affected by [tornadoes across Canada](#), more research is needed to fully understand the nature of the changes anticipated (Jafarpur & Smith 2024).
- Some evidence has suggested that Canadian tornados and [severe wind hotspots are shifting eastwards](#)—a worrying trend that would increase risks for densely populated parts of Ontario and Quebec (Zadorsky 2024).
- Atmospheric warming from greenhouse gas emissions makes [larger and more damaging hailstones](#) more likely to develop (Gensisni et. al, 2024). In southern Alberta, hailstorms are expected to become [more frequent and severe](#) due to climate change (Zhao 2024).

### **Climate change is increasing the frequency, strength, and rapid intensification of tropical cyclones and hurricanes, particularly in the Atlantic**

- Most of the heat energy captured by greenhouse gas emissions is absorbed by the oceans, providing [fuel for increasingly powerful tropical cyclones](#) and hurricanes (Climate Central, 2024). Human-driven increases in sea surface temperature made [84 per cent of hurricanes from 2019-2023](#) more powerful than they would have otherwise been (Gilford et. al 2024). Every hurricane in 2024 had [higher wind speeds](#) because of climate change (Climate Central 2024).
- Hurricanes are [forming more frequently in the Atlantic Ocean](#) due to human-caused warming (Emanuel 2021). The proportion of [very intense tropical cyclones](#) is projected to increase worldwide, and their destructive power is enhanced by rising sea levels and increased precipitation rates associated with anthropogenic climate change (Knutson et. al 2021).
- Hurricanes in the Atlantic are [intensifying more rapidly](#), leaving communities less time to prepare. It is now twice as likely for hurricanes in the Atlantic to develop from a category 1 to a major hurricane (category 3 or higher) within 24 hours compared to the 1970s and 80s (Garner, 2023).
- Sea-level rise fuelled by climate change leads to [more powerful storm surges](#), increasing the extent of coastal flooding and damage from hurricanes (Madge & Smith 2024).
- Hurricanes pose growing economic and safety risks for communities in Atlantic Canada, with high winds, flooding, and storm surges destroying homes and coastal infrastructure. Hurricanes are projected to [form and intensify at higher latitudes](#) in a warming climate, increasing the probability

that more dangerous storms will reach Canadian coasts (Studholme et. al 2022).

### Canada needs to adapt to changing and intensifying storm patterns

- More research is needed to understand changing storm patterns and regional differences with more certainty. Forecasting and [alert systems](#) for extreme weather [need to be improved](#) to allow communities to better prepare and respond to dangerous events (Bongiorno 2024; MacDonald 2024).
- Building codes must be enhanced to favour [more resilient materials, designs and constructions](#) in high risk areas, including [wind and hail-resilient roofing](#).
- Government supported [grants](#), rebates, and retrofit programs can expedite [more resilient construction and renovation](#) (Porter 2023; Wawanesa 2021).
- [Land use regulations](#) and infrastructure can be deployed to better protect coastal communities from storms and hurricanes. For example, communities can ensure buildings are located far enough from coastal areas prone to storm surge and erosion through minimum setback standards, or by using [nature-based solutions](#) to stabilize shorelines and increase coastal resilience (Richardson & Otero 2012; Halifax Regional Municipality 2024).
- [Updating land use policies](#) and incentives can help to direct new housing development away from areas prone to hail and tornadoes and other storm hazards (Strader et al. 2018).

### Resources:

- [The Canadian Severe Storms Laboratory \(CSSL\)](#) (Western University)
- [Climate Change and Thunderstorms](#) (ClimateData)
- [Hurricanes and Climate Change in Atlantic Canada](#) (ClimateData)
- [Wind](#) (Institute for Catastrophic Loss Reduction)
- [Hail Resource Hub](#) (Institute for Catastrophic Loss Reduction)
- [How can we prepare our homes and buildings to be climate resilient?](#) (Climate Resilient Retrofits)

### Experts available for comment and background information on this topic:

- **Ryan Ness** is Director of Adaptation Research at the Canadian Climate Institute and the lead researcher on the Institute's Costs of Climate Change series (Eastern Time, English and French).

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