

# Wind Speed Trends in Alberta

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## Executive Summary

Home insurance costs have dramatically increased in Alberta over the last year. TD Insurance has blamed the cost increase on increasing frequency and severity of wind and hail storms as well as wild fires and floods. The hourly maximum wind speed trends from 2015 and 1970 to 2025 were calculated for four of the largest cities in southern Alberta (Edmonton, Red Deer, Calgary and Lethbridge). The results show that the maximum wind speed calculated from hourly data over the long term from 1970 have been declining. The average trend from 1970 to Q2 of 2025 of the four cities is -2.5 km/h per decade indicating declining wind intensity. Lethbridge is the windiest city and it has the largest hourly maximum wind speed decline of -3.3 km/h per decade. A reanalysis dataset (ERA5) was used to estimate the trend of wind speeds over an area of southern Alberta from the USA border up to 50 km north of Edmonton. That dataset suggests that the wind speeds have not changed significantly since 1970. Monthly maximum wind gust are the highest wind speeds averaged over three seconds each month. In Calgary, the trend of monthly maximum wind gust from 2015 is 0.1 km/h per decade. Maximum wind gust trend is essentially zero. TD Insurance's claim of increasing wind storm frequency and severity is unjustified.

There is evidence that hail storms have increased recently in Alberta, but they have decreased in the three provinces east of Alberta. There is no evidence that hail storms have increased in Canada or globally. The recent increase of hail events in Alberta is likely due to natural variability. It is not likely that hail storms will increase in Alberta in the future. There is no evidence that wild fires or floods will increase in the future.

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TD Insurance has dramatically increased home insurance premiums in Alberta this year. The home insurance document states;

“The increased cost of repairs and increased occurrence of severe weather and natural disasters in Alberta have affected your premium. ... The increased frequency and severity of wind and hail storms and catastrophes such as wild fires and floods are examples of factors that have affected the cost of home insurance in Alberta.”

This article primarily addresses the claim by TD Insurance that severe wind storms are contributing to increasing home insurance premiums. Appendix 2 briefly discusses hail storms, wild fires and floods.

I examined the wind speeds at the four largest cities by population in southern Alberta using average and maximum wind speed data from [Historical Data](#) section of the Government of Canada’s [Environment and Natural Resources](#) website. The wind speed data were accessed through the [Canada Weather Stats](#) website.

I created graphs of monthly and quarterly average and maximum wind speeds recorded at four cities in southern Alberta; Edmonton, Red Deer, Calgary and Lethbridge. Monthly data were plotted from January 2015 to June 2025 to indicate the short term wind speed trends. This period of 10.5 years is much shorter than 30 years that is usually used to define a normal climate baseline. The graphs are given in appendix 1. The Canada Weather Stats website provides only 10.75 years of monthly data. Longer records are provided with quarterly data. Quarterly data were plotted from the third quarter (Q3) of 1970 to the second quarter (Q2) of 2025 to calculate the long term trends.

I also created graphs showing the monthly average and maximum wind speeds from the ERA5 reanalysis dataset of the area of latitude 49° - 54° North, longitude 110° - 115° West. This area encompasses the four major cities of southern Alberta and extends from the Rocky Mountains to the Saskatchewan border and from the USA border to 50 km north of downtown Edmonton. The ERA5 reanalysis dataset was accessed through the [KNMI Climate Explorer](#) website. [ERA5](#) is the fifth generation of the European Centre for Medium-Range Weather Forecasts (ECMWF) Re-Analysis. The area resolution of the ERA5 data is 0.25° latitude and 0.25° longitude. The ERA5 area analyzed contains 400 grid cells. The ERA5 monthly maximum wind speeds reported here are the maximum of the wind speeds of the 400 grid cells. Therefore, the ERA5 maximum winds speeds are not

directly comparable to the monthly maximum wind speeds of the cities which are the maximum of 720 hourly wind speeds in months with 30 days.

Table 1 shows the average of the hourly wind speeds and the average of the monthly maximum wind speeds of each of the four cities, the average of the four cities over the period January 2015 to June 2025. The last line of the table shows and the average wind speed over the area 49° - 54° N latitude, 110° - 115° W longitude of southern Alberta as determined by the ERA5 over the period January 2015 to June 2025.

<b>Table 1</b>	<b>Alberta Wind Speeds in km/h</b>	
Location	Hourly Average	Ave. of Monthly Maximum
Edmonton	10.6	34.0
Red Deer	12.1	44.2
Calgary	13.8	48.7
Lethbridge	15.8	54.0
4-City Ave.	13.1	45.2
ERA5	12.2	

Wind speeds are measured hourly and are averaged over ten minutes. Averaging helps to filter out short-term fluctuations and provides a more stable and representative measure of the wind speed for a given hour.

The average wind speed of the four cities over the period 2015 to June 2025 was 13.1 km/h. The average monthly maximum of the four cities was 45.2 km/h. The average and monthly maximum wind speeds increase from north to south. The ERA5 southern Alberta wind speed was 12.2 km/h which is a little less than the average of the four cities. This suggests that rural wind speeds are less than urban wind speeds. However, I would expect the urban wind speeds would be less than rural wind speed due to many taller building blocking the wind. It is more likely that ERA5 has a low wind speed bias.

Table 2 shows the wind speed trends from January 2015 to June 2025 and from 1970 to June 2025 of four cities in Alberta, their average and the area defined for the ERA5 analysis. The trends were calculated by best fit linear regression in Excel. The trends of maximum wind speed starting in 2015 were calculated on the

monthly maximum of hourly wind speeds. The trends of the maximum wind speeds starting in 1970 were calculated on the quarterly maximum of hourly wind speeds.

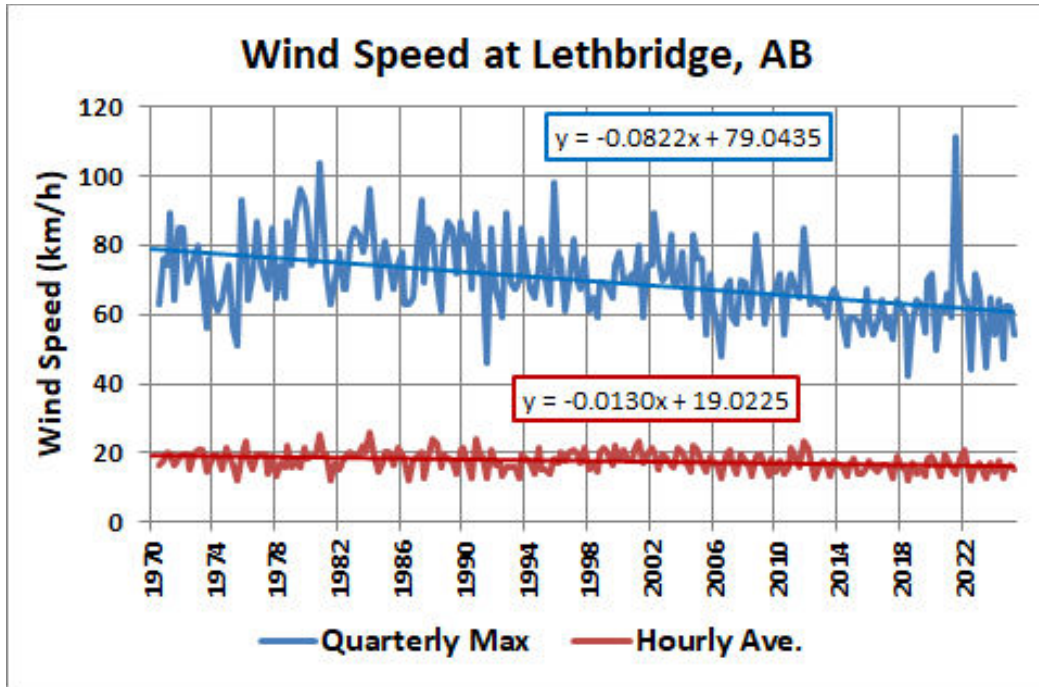
The analysis shows that the 4-city average of the monthly maximum and average wind speeds in southern Alberta have been declining over both the short term and the long term.

<b>Table 2</b>	<b>Alberta Wind Speed Trends in km/h/decade</b>			
	From 2015-01 to 2025-06		From 1970-01 to 2025-06	
Location	Average	Maximum	Average	Maximum
Edmonton	-2.03	-3.46	-0.33	-2.08
Red Deer	0.46	-0.31	-0.70	-1.84
Calgary	0.40	-0.10	-0.39	-2.59
Lethbridge	-0.29	1.39	-0.52	-3.30
4-City Ave.	-0.37	-0.62	-0.49	-2.45
ERA5	0.53	0.70	-0.04	0.00

The maximum hourly wind speed trends since January 2015 of three cities are negative, indicating declining wind speeds while Lethbridge had a small increase. The average maximum hourly wind speed decline of the four cities was -0.62 km/h per decade. This is a small decline. This short term trend represents a -1.4% (-0.62/45.2) decline of average maximum wind speeds per decade.

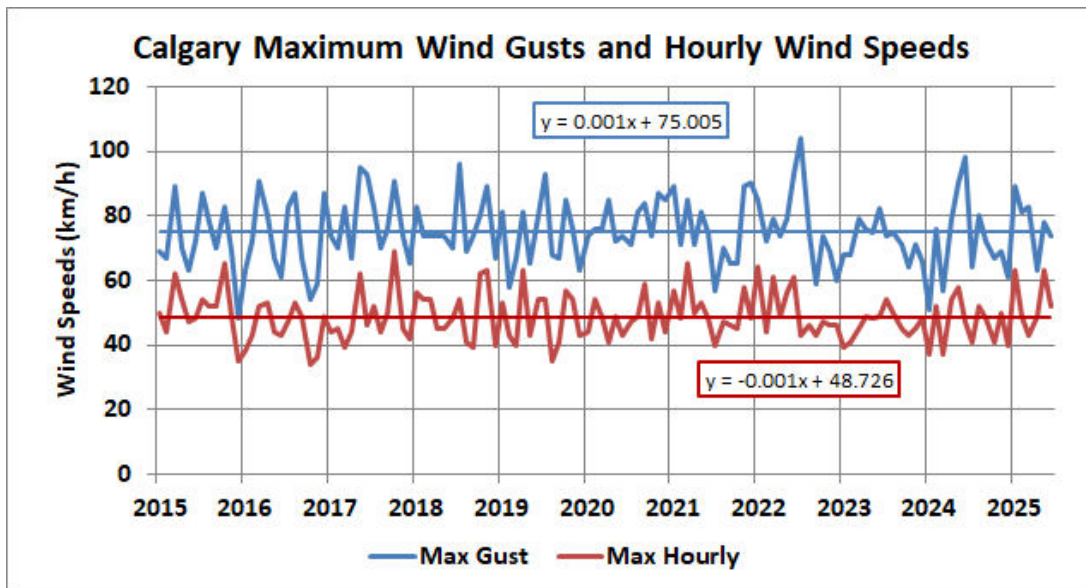
The 4-city average long term maximum wind speed trends over the period January 1970 – June 2025 are much more negative than the short term trends. The average trend of maximum hourly wind speed of the four cities was -2.5 km/h per decade. This represents a maximum wind speed decline of 5.4% per decade.

Lethbridge is the windiest city of the four and it has the largest long-term maximum wind speed decline of -3.3 km/h per decade. The average hourly wind speeds have declined as the quarterly maximum wind speeds declined. The 4-city average hourly wind speeds have declined at about -0.5 km/h/decade. The graph shows the long term maximum wind speed trend at Lethbridge.



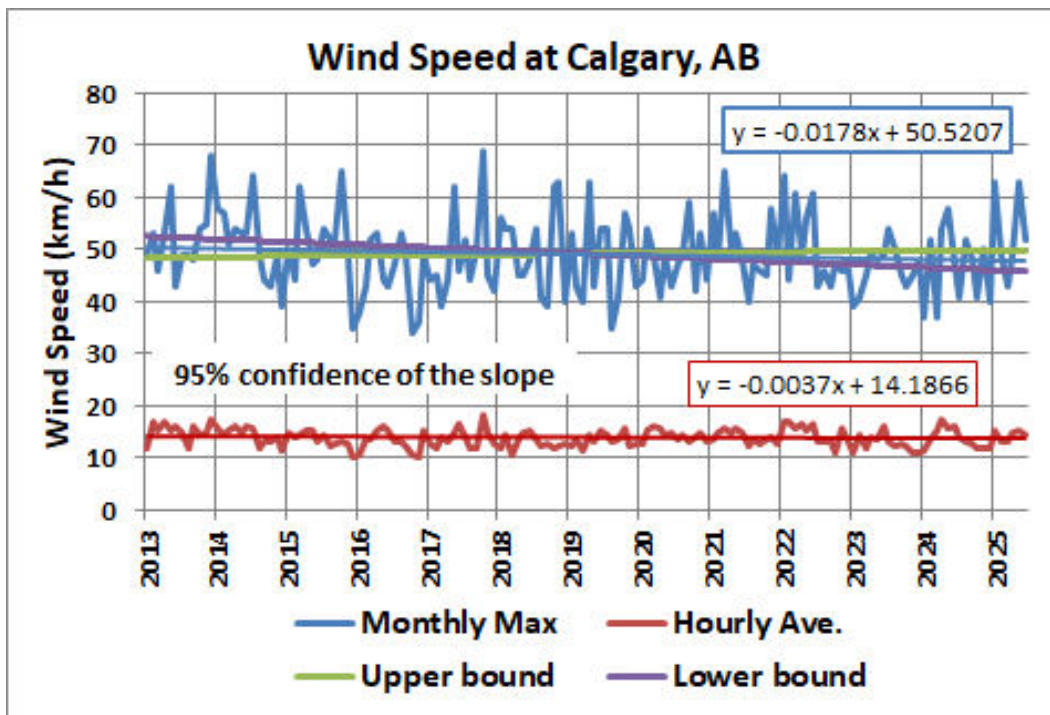
The ERA5 reanalysis dataset is considered the best available. It is global weather model that incorporates a large number of weather parameters, not just wind speeds. It indicates that there has been no long term change in the maximum wind speeds in southern Alberta.

Wind gust speeds are the 3-second average wind speeds. The government reports the daily maximum wind gust speeds. Here is the graph for Calgary from January 2015 of the monthly maximum wind gusts.



The average monthly maximum wind gust speed is 52% greater than the average monthly maximum hourly wind speed. The trends of maximum wind gust and maximum hourly wind speeds are almost identical at 0.1 km/h per decade and -0.1 km/h/decade, respectively. Both values are statistically no different from zero. There has been no change in either metric over the period January 2015 to June 2025. This analysis shows that TD Insurance is not justified in claiming that the severity of wind storms is increasing. In fact, each wind speed metric indicates that the severity of wind storms is either decreasing in both the short term and long term or shows no trend.

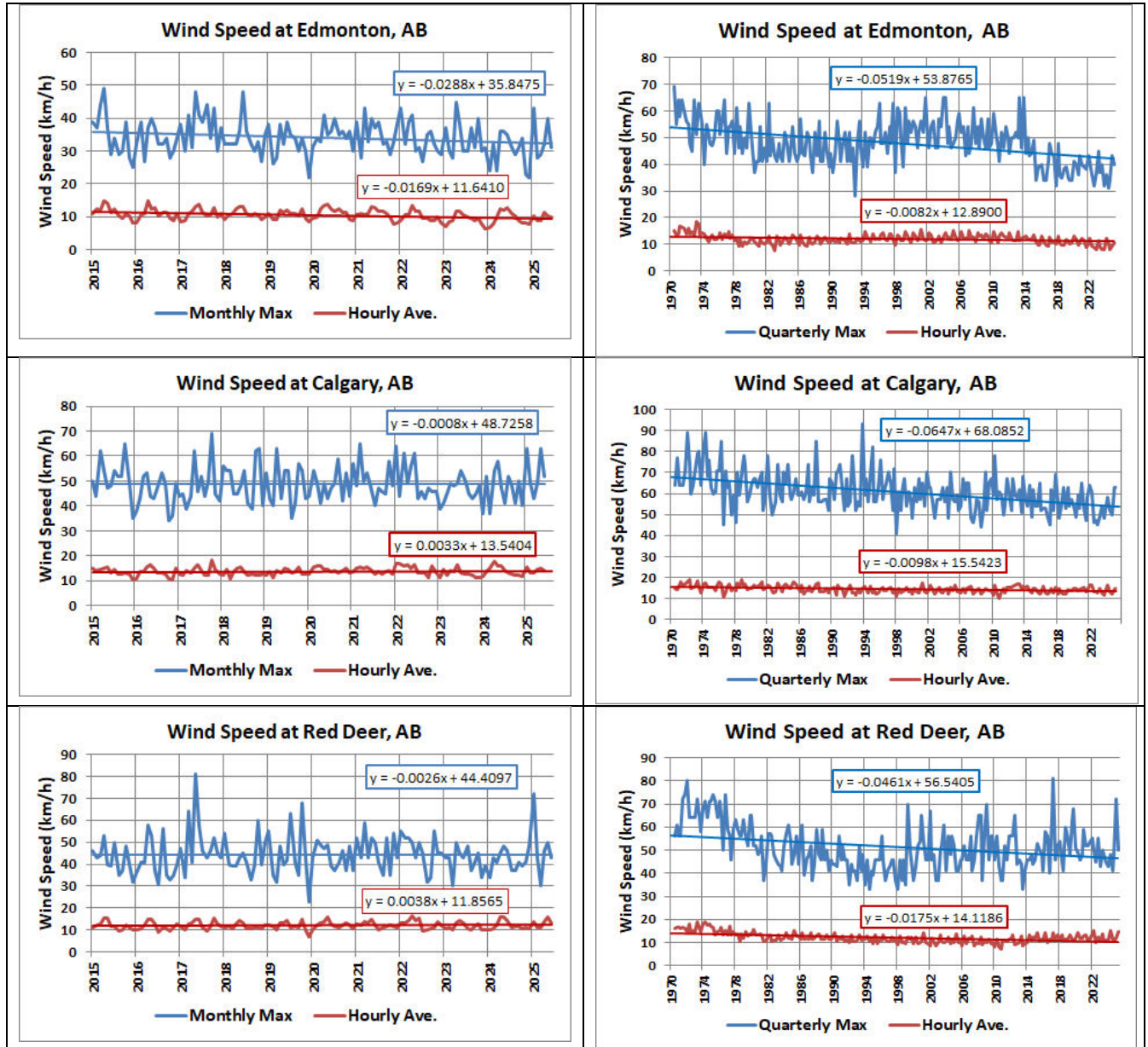
I obtained the hourly wind speed for the Calgary International Airport of each month of 2013 and most months of 2014 directly from the historical data section of the Government of Canada’s website. The plot below shows Calgary’s monthly average and monthly maximum wind speeds from January 2013 to June 2025. It shows that the average wind speed trend starting in January 2013 is -0.44 km/h per decade, whereas the trend starting in January 2015 is +0.40 km/h per decade. Adding two years of data changes the trend from slightly increasing to slightly decreasing.

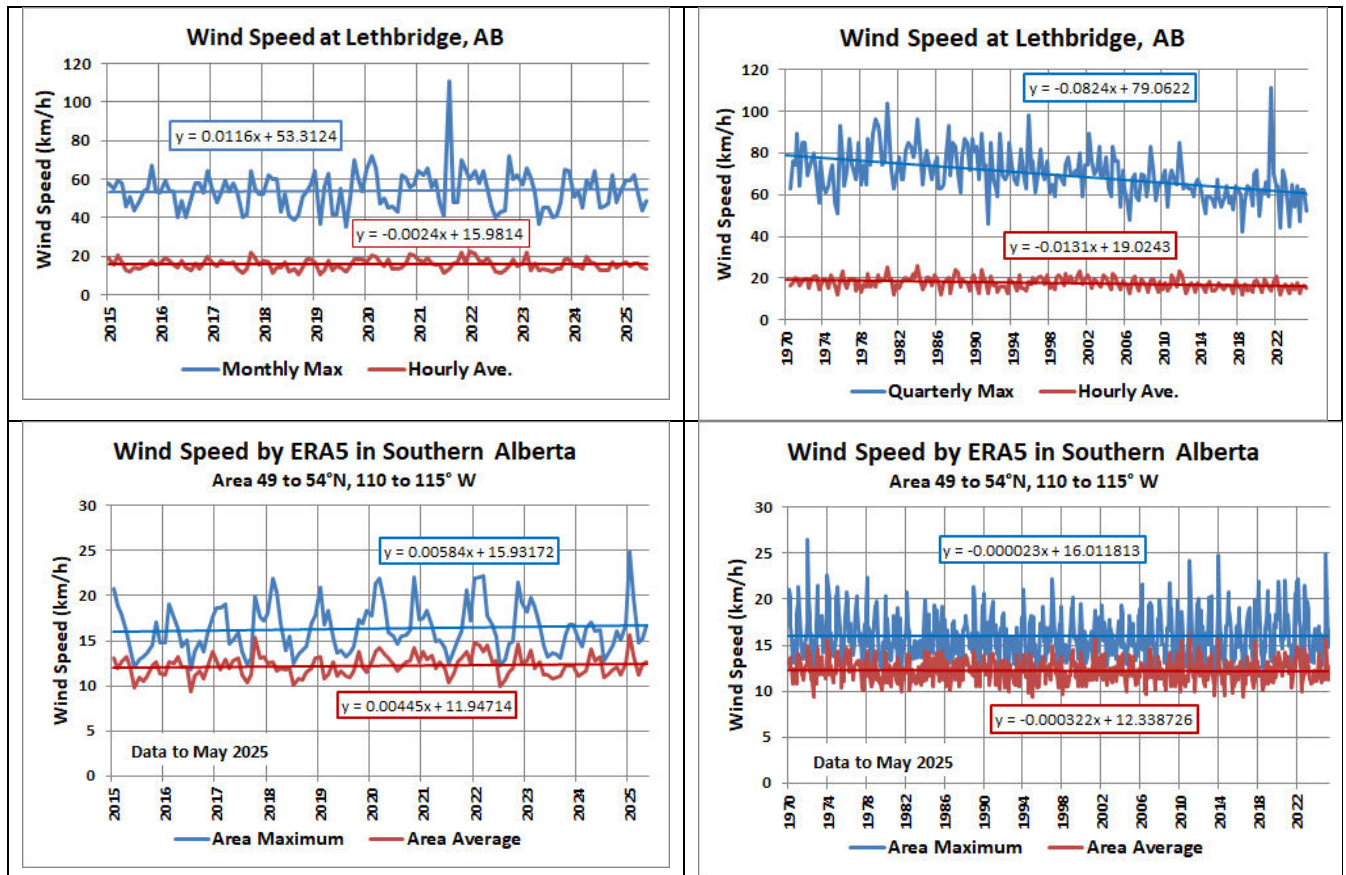


The monthly maximum wind speed trend in Calgary starting in January 2013 is -2.14 km/h per decade, which is a greater decline than the -0.10 km/h per decade of the trend starting in January 2015. The 95% confidence interval trends are shown for the maximum wind speed trend. Due to the large variability of the maximum wind speeds, the analysis shows with 95% confidence that the actual trend is likely  $-2.14 \text{ km/h/decade} \pm 3.26 \text{ km/h/decade}$ . The real trend is 95% likely to be between increasing at 1.12 km/h/decade and decreasing at 5.40 km/h/decade. The long term trends have less uncertainty and are more reliable than the short term trends.

# Appendix 1

Here are graphs of wind speeds at four cities in Alberta over the short term from 2015 and the long term from Q3 of 1970 and of southern Alberta area defined by latitude 49° - 54° N, longitude 110° - 115° W according to the ERA5 dataset. The short term graphs are on the left and the long term graphs are on the right.





## Appendix 2

TD Insurance claims that increasing hail storms, forest fires and floods are causing home insurance rates to increase.

### Hail

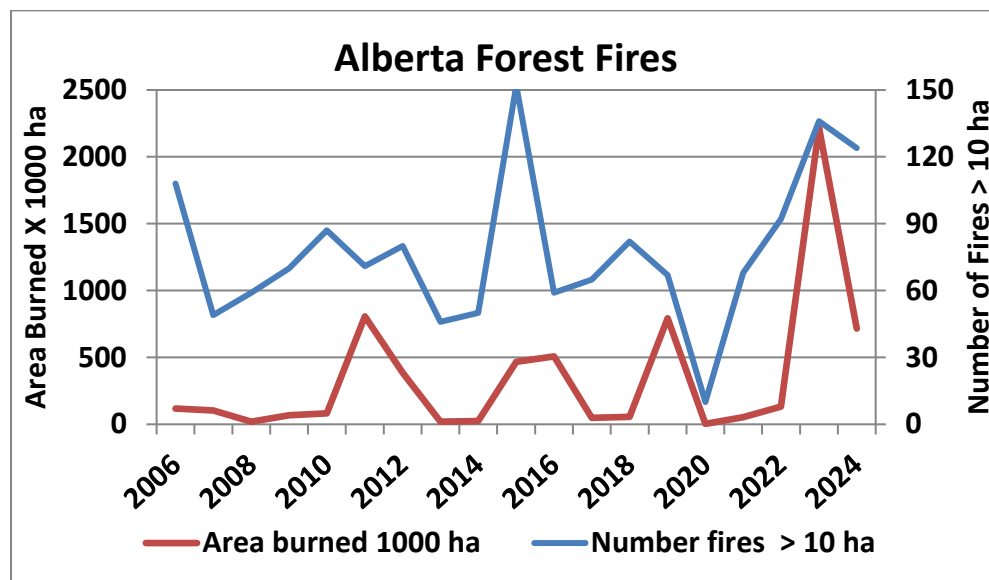
There is some evidence that hail storms have increased in Alberta, while they have decreased in Saskatchewan. The [paper](#) titled “Hail Climatology for Canada: An Update” dated February 2018 by David Etkin of York University investigated hail storms in Canada. The paper states “Just three wind/water/hail events in Alberta (2010, 2012 and 2014) totaled more than \$1.66 billion in insured losses.” Very rare severe hail events cause the most of the hail damage. Future trends are unclear in terms of severe convective storms. Hail storms and tornadoes require significant wind shear and high convective available potential energy to develop. Climate models simulations suggest that wind shear will decrease, reducing hail storms, while convective potential energy will increase, increasing hail storms. It

is not clear which of these opposing factors has the larger effect. The author wrote “the interpretation of how individual hazards will change is open to question.”

The hail frequency in Alberta in terms of hail days per observation station has been increasing in Alberta since 1977 with large yearly variability. However, hail frequency in Saskatchewan, Manitoba and Ontario has been declining. There is no known reason that hail storms should increase in Alberta while decreasing in the three provinces east of Alberta. The increase of hail frequency in Alberta may simply be due to natural climate variability and may decrease in the future.

### Forest Fires

The graph below shows the number of forest fires in Alberta that are greater than 10 ha of area, and the total burned area from 2006 to 2024. The data are from [OpenAlberta](#). The burned area is mostly between 50,000 ha and 800,000 ha. The burned area in 2023 was very high at 2.2 million ha.



The Jasper forest fire of July 22, 2024 destroyed 358 out of 1113 structures, including homes and businesses, according to official reports. See [this video](#) about the Jasper forest fire produced by the Friends of Science Society. This [document](#) from the Government of Alberta says that fires in mountain pine beetle (MPB) infested forests burn more intensely than in unaffected pine forests. Between the

most recent population peak in 2019 and 2023, [MPB populations](#) have declined provincially by 98%.

The Canadian National Fire Database shows there has been a significant decline in the number of wildfires in Canada from 1990 to 2022. The area burned per year is quite variable, but there is a general decline of area burned from 1980 to 2022 as shown on their [graph here](#). The large increase of burned area in 2023 doesn't portend an increasing trend. The 2024 burned area dropped to below that of 2019 and 2011.

## Floods

Southern Alberta experienced major flooding in June 2013, but there were greater floods in earlier decades. In June 2005, Calgary experienced a flood that was, at that time, the largest in decades. Calgary received three times its normal monthly rainfall, causing rivers and creeks to flow higher than usual. Before the 2005 flood (791 m<sup>3</sup>/s), the eight worst recorded floods in Calgary's history occurred before 1933. In 1879 and 1897, the peak flow rates were about 23% higher than the 2013 flow rate. The Bow River floods of 1902 and 1932 were almost as bad as the 2013 flood with flow rates at more than 82% of the 2013 flood. Flood damage costs increase due to people building more expensive structures on flood plains. There is no evidence that floods are getting worst in Alberta. [Here is a chart](#) of maximum flow of the Bow River at Calgary. The table below shows the 7 largest Bow River peak flows above the Elbow River sorted by flow rate. The most recent flood in 2013 is highlighted.

<b>Bow River Peak Flow above the Elbow River</b>			
<b>Rank</b>	<b>Year</b>	<b>Peak Flow</b>	
		m <sup>3</sup> /s	
1	1879	2265	estimate
2	1897	2265	estimate
3	<b>2013</b>	<b>1840</b>	
4	1902	1557	estimate
5	1932	1520	
6	1929	1320	
7	1915	1130	

There is no evidence of an increase of flooding on a global scale. The Sixth Assessment Report of the IPCC found that peak water flow trends varied significantly by region and “lacked statistical significance of an increase or decrease over the globe as a whole”. In addition, the report stated that evidence of a climate change signal with respect to river flooding is not present for all time frames out to at least 2100.

The risk of floods should be borne by those who choose to live and build structures on flood plains. Flood costs shouldn't be charged to home owners who do not live on flood plains.