

Climate Variability, Urban Crime, and Public Perceptions of Safety in Canadian Prairie Cities

Rationale

This project examined the link between climate variability and urban crime patterns in Canadian Prairie cities. While international research shows weather-crime links, these cities are understudied. This gap is crucial because cities like Saskatoon, Regina, Winnipeg, and Edmonton experience unique climatic conditions distinct from warmer cities where much research is conducted.

The project posits climate doesn't directly cause crime but influences conditions making crime more or less likely. For example, warmer weather may increase outdoor activity and social interaction, creating more opportunities for crime. Extreme cold may reduce outdoor activity and suppress street-level crime. Climate stress may also affect public safety perceptions and online crime discussions. Thus, the study treated climate, crime, and perception as interconnected but distinct urban safety dimensions.

Focusing on Saskatoon, Regina, Winnipeg, and Edmonton, the project examined whether climate-crime relationships are regionally consistent or city-specific. These cities, differing in size, structure, crime trends, climate exposure, and discourse, served as case studies. The study addressed the need for evidence to support climate-responsive public safety planning, especially in mid-sized, cold-climate Canadian cities.

Research Questions

The study addressed two main research questions within the broader climate-crime research program:

- 1. How do climate variables, including temperature, precipitation, humidity, and derived thermal indices, correlate with crime patterns across different seasons in Prairie cities?**
- 2. What spatial patterns emerge when climate trends and crime data are compared across Saskatoon, Regina, Winnipeg, and Edmonton?**

A related objective was to examine whether social media sentiment can provide a useful indicator of public perceptions of crime and safety. Reddit-based city subreddit discussions were used to assess how public concern about crime changed across time and whether crime-related sentiment differed from general online discussion. The study therefore integrated objective crime data, climate records, and public perception data into a single analytical framework.

Methodology

The project used a computational social science approach combining three data sources: climate data, police-reported crime data, and Reddit-based sentiment data. Daily climate data were obtained from Environment and Climate Change Canada for Edmonton, Regina, Saskatoon, and Winnipeg, including mean, minimum, and maximum temperature, total precipitation, relative humidity, wind speed, atmospheric pressure, visibility, humidex, wind chill, heating degree days, and cooling degree days. Averaged city-level values represented climatic conditions, with missing data imputed using variable-specific strategies. Variables with excessive missingness were excluded. Crime data were from Statistics Canada's Uniform Crime Reporting Survey, focusing on "actual incidents" for Edmonton, Regina, Saskatoon, and Winnipeg. Crime records were grouped into violent crime, property crime, and total Criminal Code violations. These were aggregated by city and year for longitudinal comparison. Reddit posts from city-specific and province-specific subreddits, including r/Edmonton, r/Winnipeg, r/Regina, r/Saskatoon, and related communities, were analyzed using VADER sentiment analysis. Crime-relevant posts were identified using a rule-based keyword filter. Several normalization steps were included, such as

post-level normalization, user-level aggregation, and population-normalized post rates, to avoid misleading comparisons due to city size and subreddit activity. The analysis was organized into five eras: 2009–2013 as an early baseline, 2014–2019 as a consolidation period, 2020–2021 as the pandemic disruption, 2022–2023 as post-pandemic re-stabilization, and 2024–2025 as the most recent mature period. Statistical methods included Kruskal-Wallis tests, chi-square tests, Mann-Whitney pairwise comparisons, Wilcoxon signed-rank tests, temporal trend analysis, volatility analysis, and city-specific ordinary least squares regression models examining annual violent crime in relation to temperature, humidity, and negative Reddit sentiment.

Findings

The results show that climate-crime relationships in Prairie cities are real but not uniform. The strongest climate-crime signals were found in Edmonton and Winnipeg, while Saskatoon and Regina showed weaker or less stable model performance. This confirms that Prairie cities should not be treated as one homogeneous regional group.

In Edmonton, the findings suggest that hot and dry conditions are associated with higher violent crime. Cooling degree days showed a positive association with violent crime, while relative humidity showed a negative association. This indicates that dry heat may be a particularly important environmental stressor in Edmonton. The results are consistent with the idea that high heat and low humidity can increase physical discomfort and stress, which may contribute to conditions associated with violent crime. The Edmonton model showed the strongest overall performance, with climate and sentiment variables together explaining a meaningful share of year-to-year variation in violent crime.

Winnipeg showed a different pattern. Extreme cold days were negatively associated with violent crime, suggesting that very cold conditions may suppress outdoor activity and reduce opportunities for some forms of crime. This supports the routine activity explanation, where crime opportunities change depending on whether people are outside, moving through the city, or interacting in public spaces. However, Winnipeg's crime increase appears to be influenced strongly by broader social and economic factors rather than climate alone. Negative Reddit sentiment was a strong co-indicator of violent crime in Winnipeg, suggesting that online public concern may reflect broader community stress and perceived insecurity.

The sentiment analysis produced an important methodological finding. In the early period from 2009 to 2013, Reddit discourse was sparse, reactive, and incident-driven. It could not reliably function as a continuous measure of public perception. By 2014–2019, crime-related sentiment became more stable and clearly distinguishable from general subreddit sentiment. Crime posts became consistently more negative than non-crime posts across all four cities. This confirms that crime sentiment can be treated as a distinct public perception indicator, rather than simply a reflection of general online negativity.

During the pandemic period, crime-related sentiment became disrupted and fragmented, reflecting the broader social disruption of COVID-19. In the post-pandemic period, sentiment began to stabilize again, and by 2024–2025, the data became more analytically reliable. The most recent era provides the strongest foundation for future climate-crime-perception modelling because crime sentiment is more continuous, more distinct from general discussion, and less dominated by isolated shocks.

The study also found clear differences among cities. Regina repeatedly appeared as a more positive sentiment outlier, even when crime-related issues were discussed. Winnipeg showed stronger negative sentiment growth, with public concern rising sharply in relation to crime conditions. Saskatoon occupied an intermediate position, where some signals were present but not strong enough to support firm

conclusions with the current annual dataset. These findings show that public perception is shaped not only by crime rates, but also by local discourse culture, city identity, media dynamics, and broader social conditions.

Conclusions

The project concludes that climate variability is a relevant but city-specific factor in understanding urban crime risk in Canadian Prairie cities. The relationship is not simple or universal. Heat, dry conditions, cold extremes, and precipitation may influence crime differently depending on the local urban context. Edmonton appears more sensitive to hot-dry climate stress, while Winnipeg shows evidence of cold-related crime suppression and a stronger relationship between crime and public sentiment. Regina and Saskatoon require further investigation at finer spatial and temporal scales.

A major contribution of the project is the development of an era-stratified framework for using social media sentiment as a public perception measure. The findings show that Reddit sentiment is not equally reliable across all time periods. It becomes more useful once online discussion reaches sufficient volume, continuity, and stability. This is important for future research and public monitoring because it shows when social media data can support urban safety analysis and when it should be treated with caution.

Overall, the study provides evidence that climate adaptation and public safety should not be treated as separate policy areas. In Prairie cities, changing climate conditions may influence both crime patterns and how residents perceive safety. These relationships are likely to become more important as heat events, seasonal instability, and climate volatility increase.

Implications for Policy and Practice

The findings suggest that municipalities should begin incorporating climate-sensitive indicators into public safety planning. This does not mean that climate should replace established explanations of crime, such as poverty, housing instability, substance use, or policing practices. Rather, climate should be treated as an additional environmental factor that may intensify or suppress crime risk under certain conditions.

For practice, the results support the development of city-specific climate-crime dashboards or monitoring systems that combine weather indicators, crime statistics, and public perception measures. Such systems could help cities identify periods when heat, dry conditions, or other climate stressors may coincide with elevated safety concerns. This could inform targeted deployment of community services, outreach, cooling supports, lighting improvements, transit safety measures, and public communication.

The study also highlights the value of public perception monitoring. Official crime statistics show recorded incidents, but they do not capture how residents feel about safety or how concern circulates in the community. Carefully analyzed social media sentiment can provide an additional layer of information, especially when interpreted alongside crime and climate data. However, this must be done cautiously, with attention to platform bias, unequal participation, and city-specific online cultures.

For policy, the main implication is that public safety planning in Prairie cities should become more climate-responsive and locally grounded. A single regional model is not sufficient. Edmonton, Winnipeg, Saskatoon, and Regina each require tailored approaches based on their climate exposure, crime trends, urban structure, and public perception dynamics. Future work should extend this study to neighbourhood-level analysis, include additional socioeconomic variables, and examine lagged relationships between extreme weather, crime outcomes, and public sentiment. This would provide stronger evidence for designing targeted, equitable, and climate-aware urban safety interventions.