Analysis of Long-Term Climate Trends and Extreme Events in St. John's, NL (1942–2012)

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***Abstract*—This project proposes a detailed analysis of historical climate data for St. John's, NL, from 1942 to 2012. Objectives include identifying major long-term trends in temperature and precipitation, applying a Growing Degree Days (GDD) metric, analyzing extreme weather events, and decomposing annual trends into seasonal components.**

I. Introduction

The city of St. John's, Newfoundland and Labrador, exhibits a distinct oceanic climate influenced by its coastal and geographic position. [1].

This project aims to quantify these changes using rigorous data analysis. The main objectives are:

1) Identify long-term trends in core climate variables, including temperature and precipitation.
2) Develop and apply a derived metric, Growing Degree Days (GDD), to translate temperature data into a measure of agricultural impact.
3) Analyze extreme weather events and investigate whether their frequency has changed over time.
4) Decompose annual trends into seasonal components.

II. Dataset Identification

The dataset originates from the St. John's A weather station (Climate ID: 8403506) and spans 70 years from January 1942 to March 2012 [2]. The data is sourced from the historical archives of Environment and Climate Change Canada.

The dataset summaries of key weather-related variables:

- Mean, maximum, and minimum temperatures (°C)
- Extreme maximum and minimum temperatures (°C)
- Total rain (mm), snow (cm) and total precipitation (mm)
- Wind gust speed (km/h) and direction

III. Initial Data Exploration

An initial analysis of the dataset reveals long-term warming patterns. Figure 1 shows the annual mean temperature in St. John's from 1942 to 2012.

IV. Proposed Methodology and Implementation

The project will extend beyond basic descriptive plots by developing quantitative functions and metrics.

A. Derived Function: Growing Degree Days (GDD)

A function will be derived to calculate GDD, which measures heat accumulation relevant to plant and animal growth.

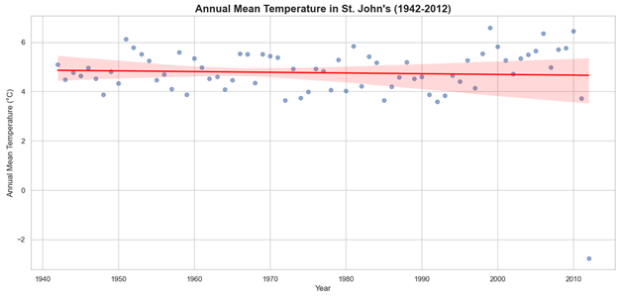

Fig. 1. Annual Mean Temperature in St. John's, NL (1942–2012).

B. Extreme Value Analysis

This component will focus on identifying long-term changes in extreme weather behavior.

1) Threshold-Based Frequency Analysis: Two thresholds (moderate and extreme) will be defined. The number of months in each decade exceeding these thresholds will be counted.

2) Record-Breaking Event Analysis: Each decade will be analyzed for record-breaking monthly highs and lows, allowing identification of whether climatic extremes are increasing.

C. Seasonal and Precipitation Trend Analysis

- **Seasonal Analysis:** The dataset will be divided into four seasons: winter, spring, summer, and fall for analysis.
- **Precipitation Trend Analysis:** The relationship between snow and rainfall totals will be analyzed to identify shifts in the form of precipitation over time.

V. Conclusion

This project will deliver a data-driven understanding of climate evolution in St. John's, NL. By combining statistical analysis, derived metrics, and seasonal decomposition, it will reveal how local climate patterns have shifted and their potential implications for regional ecosystems and infrastructure.

References

[1] S. M. Milrad, E. H. Atallah, and J. R. Gyakum, "Synoptic-Scale Characteristics and Precursors of Cool-Season Precipitation Events at St. John's, Newfoundland," *Monthly Weather Review*, pp. 667–689, 2009.

[2] Environment and Climate Change Canada, "Monthly Climate Data for St. John's, Newfoundland," Government of Canada, Mar. 2010. [Online]. Available: https://climate.weather.gc.ca/climate_data/monthly_data_e.html?StationID=6720&Year=2010&Month=3&Prov=NL&timeframe=3. [Accessed: Oct. 19, 2025].