ACENET

Microcredential in Advanced Computing

ISP Report

Project title: Climate Change in the Stephenville area over 30 years

Participant name: Jamie Goosney

Date: July 10, 2024

Abstract:

This project analyzes climate data trends and makes future predictions for Newfoundland from 1994 to 2024. The analysis includes temperature, wind speed, precipitation, and snow on the ground, utilizing linear regression for trend identification and future projections. An attempt was also made to analyze the impact of climate change on coastal erosion in the Stephenville area.

1. **Introduction**

The project aims to analyze and predict climate data trends for Newfoundland, focusing on key variables such as temperature, wind speed, precipitation, and snow on the ground. The motivation behind this project is to understand long-term climate patterns and their implications for environmental management. The report hopes to determine the historical trends and future predictions for key climate variables in Newfoundland and Labrador. Additionally, an attempt was made to determine the impact of climate change on coastal erosion in the Stephenville area of Newfoundland and Labrador, despite the limited availability of data. Labrador?

2. **Background**

Understanding climate trends is essential for adapting to and mitigating the impacts of climate change. Newfoundland, with its unique geographical features and climatic conditions, offers a valuable case study for examining these trends. Previous studies have highlighted the importance of analyzing temperature, wind speed, precipitation, and snow accumulation to inform environmental strategies. Coastal erosion, influenced by climatic factors, is also a critical issue in the region. Although the report

was created to complete an analysis of climate change in the Stephenville area, minimal data is available other than GIS shapefiles. The average coastal erosion rate in this area is approximately 0.2 meters per year.

3. Analysis

Dataset:

The dataset used for this analysis includes climate data from 1994 to 2024, sourced from Weather Stats Canada (https://stephenville.weatherstats.ca/). The data includes daily records of temperature, wind speed, precipitation, and snow on the ground.

Data Preparation:

The data was cleaned and processed to ensure consistency and accuracy. Missing values were handled appropriately, and the date column was converted to a datetime format for time series analysis.

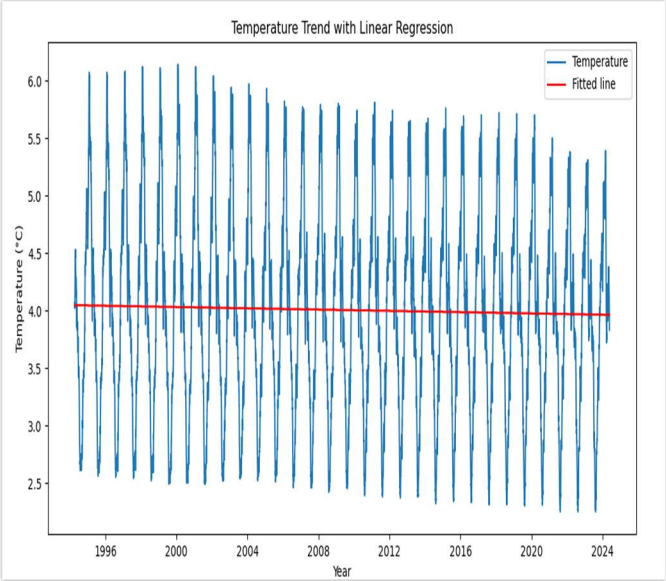
Analysis Method:

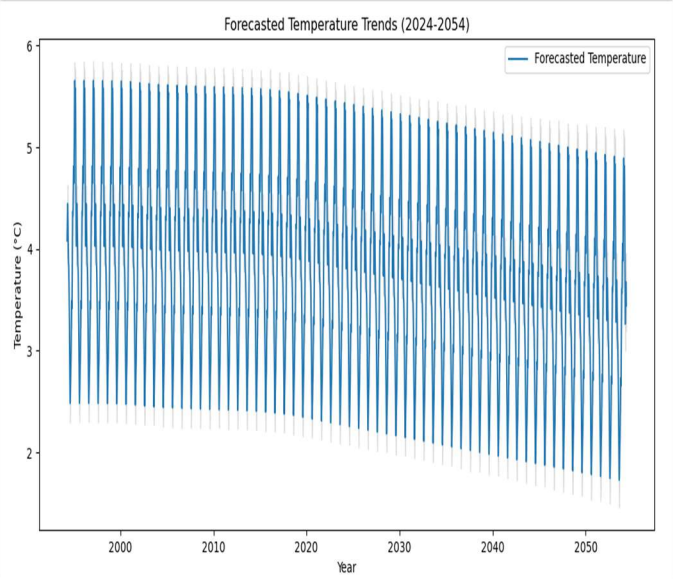
Linear regression was employed to identify trends and make future predictions for each climate variable. The slope and p-value from the regression analysis helped determine the statistical significance of these trends. The high-performance computing (HPC) courtesy of ADC Engineering (Stephenville Office) was utilized to handle the large dataset and perform complex calculations efficiently.

4. Results

Temperature Trends and Predictions:

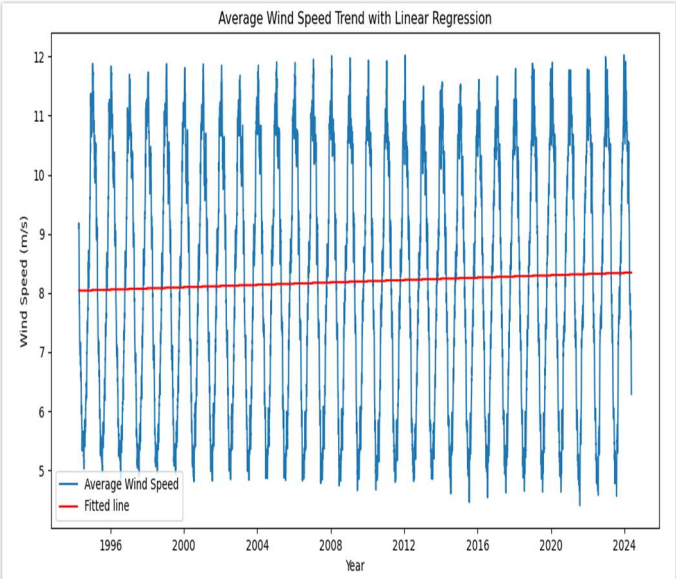
The temperature trends over time show seasonal variations with a slight but statistically significant downward trend. The slope is -0.0028°C per year, and the p-value is 0.0049, indicating statistical significance. Future predictions suggest a continuation of this downward trend.

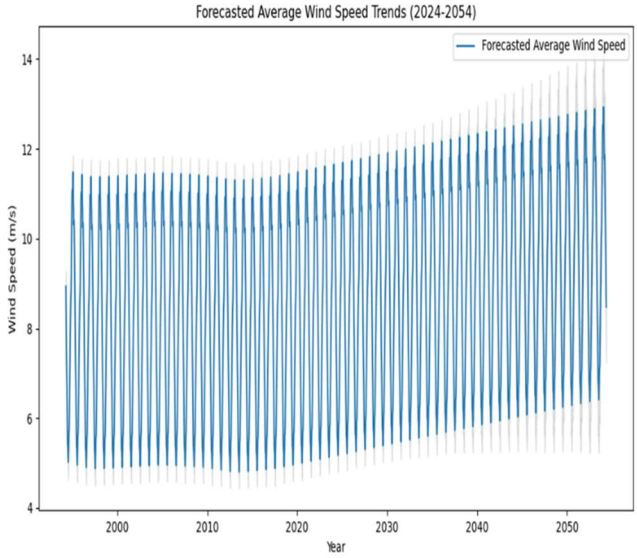




Wind Speed Trends and Predictions:

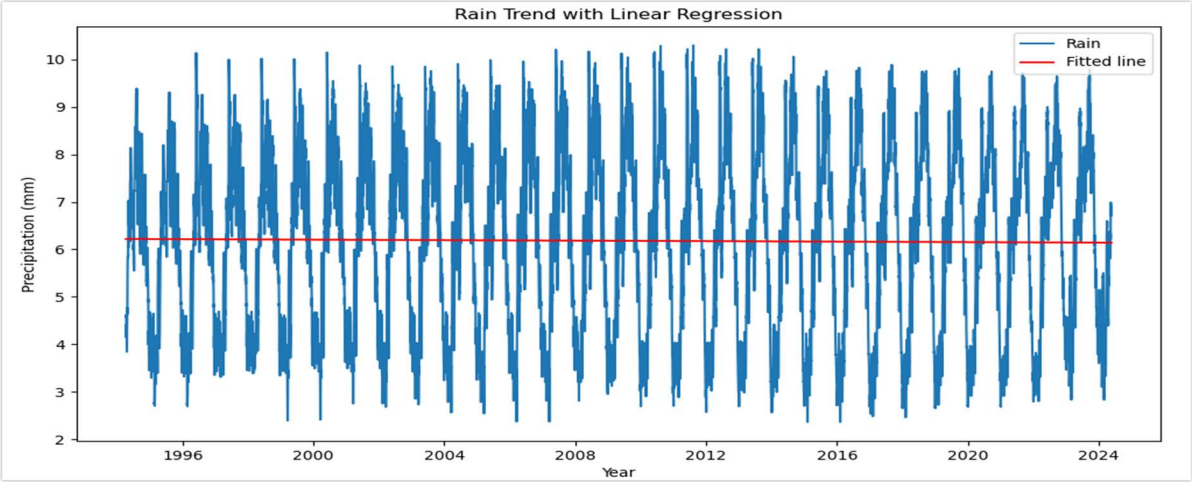
There is a statistically significant upward trend in average wind speed, with a slope of 0.0102 m/s per year and a p-value of 1.71e-05. This increase in wind speed can have various implications for weather patterns, energy production, and environmental conditions. Future projections indicate that wind speeds will continue to rise.





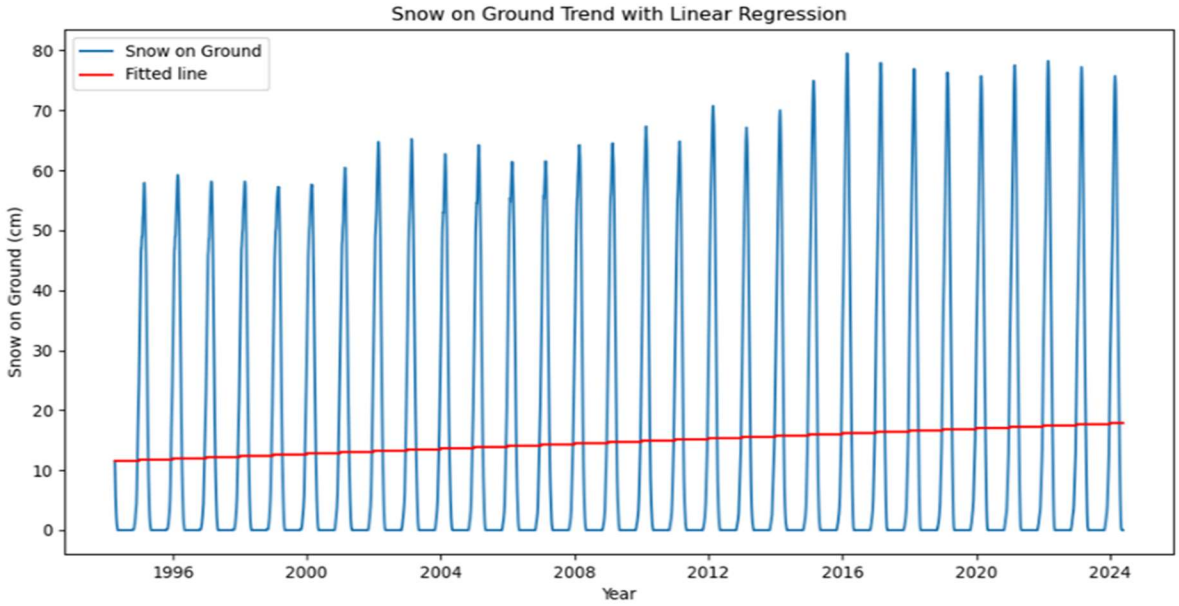
Rain Trends and Predictions:

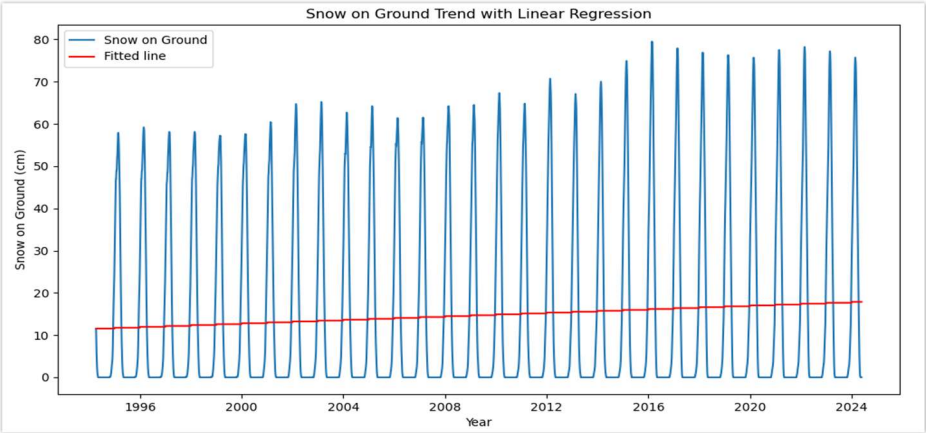
The trend in rainfall shows a slight decrease, with a slope of -0.0026 mm per year and a p-value of 0.2181, indicating no statistical significance. Predictions suggest no significant changes in the rainfall trend in the near future.



Snow on Ground Trends and Predictions:

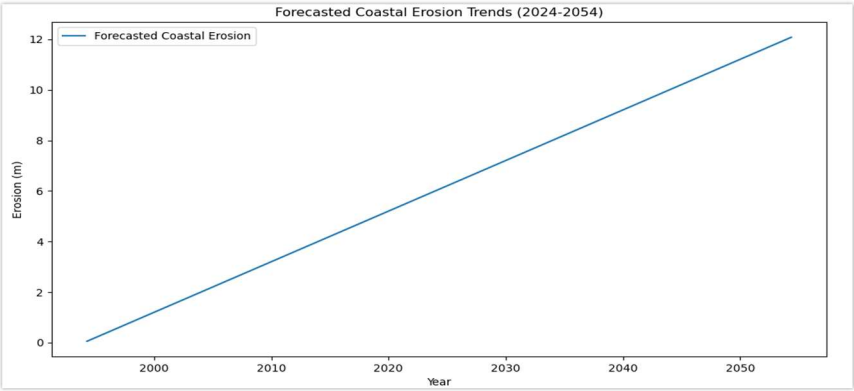
The amount of snow on the ground has shown a statistically significant upward trend, with a slope of 0.2109 cm per year and a p-value of 7.088e-18. This indicates growing snow accumulation, impacting water resources, ecosystems, and winter weather patterns. Future predictions indicate this increasing trend will continue.





5. Discussion

The analysis indicates significant trends in temperature, wind speed, and snow on the ground, while the trend in rainfall is not statistically significant. The downward trend in temperature and upward trends in wind speed and snow accumulation have important implications for regional climate adaptation strategies. Coastal erosion, influenced by climatic factors, remains a critical concern. The average erosion rate at Kippens (Seaside Drive) is approximately 20 cm per year. Historical surveys conducted in 1991, 1993, 1994, 2000, 2012, 2013, 2016, and 2017 indicate that groundwater seepage and the composition of the coastline, which includes silt, clay, sand, and gravel, contribute to the erosion process. The increasing impact from storms and sea-level rise is likely to exacerbate these erosion rates. Although minimal data is available other than GIS shapefiles, this analysis highlights the importance of addressing coastal erosion in the context of climate change.



Conclusion

This analysis of climate data from 1994 to 2024 offers valuable insights into trends and relationships among climatic variables such as temperature, wind speed,

precipitation, and snow on the ground. The results indicate a slight but statistically significant downward trend in temperature, decreasing by approximately 0.0028°C per year. Wind speed shows a statistically significant upward trend, increasing by approximately 0.0102 m/s per year, which affects weather patterns, energy production, and environmental conditions. Precipitation trends reveal a slight decrease of approximately 0.0026 mm per year, indicating no strong evidence of change. Snow on the ground shows a statistically significant upward trend, increasing by approximately 0.2109 cm per year, indicating growing snow accumulation impacting water resources, ecosystems, and winter weather patterns.

The correlation analysis reveals that temperature is negatively correlated with rainfall and positively correlated with snow, suggesting that higher temperatures are linked to less rainfall and more snow during winter months. Wind speeds, including maximum, minimum, and average, are highly correlated, indicating they vary together.

Coastal erosion is another critical issue examined in this study. The average erosion rate at Kippens (Seaside Drive) is approximately 20 cm per year. Historical surveys indicate that groundwater seepage and the coastline composition, which includes silt, clay, sand, and gravel, contribute to the erosion process. Increased storm activity and sea-level rise are likely to exacerbate these erosion rates.

The forecast for 2024 to 2054 shows a continuation of the slight downward trend in temperature. Precipitation patterns are expected to maintain current trends with slight variability, with no significant changes in rain and a continued increase in snow accumulation. Wind speeds are projected to keep increasing, potentially impacting energy production and environmental conditions. Coastal erosion rates are expected to rise due to increased storm activity and sea-level rise.

In summary, these findings provide an overview of climatic trends and their interrelationships in the Stephenville area of Newfoundland and Labrador. Understanding these patterns is crucial for developing effective strategies for climate adaptation and mitigation, as well as for informing policy decisions and environmental best management practices (BMPs).

References

- Weather Stats Canada: https://stephenville.weatherstats.ca/

Supplementary Materials

- https://github.com/jamiegoosney/ACENET-ISP