Climate Change Analysis Report: Manipal Region

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1 Introduction

This report presents an exploratory data analysis (EDA) of weather patterns in **Manipal, Karnataka**, to identify long-term trends and possible indicators of climate change. The report focuses on variations in temperature and precipitation using historical meteorological data and basic machine learning models.

Location details: * Latitude - 13.3216 N * Longitude 74.7945 E * Elevation: 97 m * Time Zone: GMT +5:30

2 Dataset Description

The dataset contains daily weather records from 2011 to 2026, including - * Temperature * Precipitation * Solar radiation * Wind Speed * Soil Moisture * Atmospheric Pressure Indicators

There were no null or missing values in the dataset.

Based on the dataset, the average temperature ranged from 22.7°C to 31.1°C, with a mean of 26.27 °C. The general rainfall patterns showed high variability with short periods of intense precipitation.

From the graphs, we identified two major seasons in Manipal: **Summer** and **Monsoon**.

3 Methodology

To analyse climate trends, we graphed seasonal variations in temperature and rainfall over time.

We also deployed a **Linear Regression** model to analyse long-term temperature trends and a **Random Forest Regressor** to study rainfall behaviour and variability. We compared results across different time periods to observe changing climate behaviour.

4 Key Findings

4.1 Temperature Trends

Using the linear regression model, we found that the average temperature rose approximately **1°C** from 2011 to 2026, indicating consistent warming in the region. This result suggests strong local effects of global climate change.

4.2 Rainfall Patterns

Using Random Forest Regressor models for the early (2011-2016) and later (2020-2026) years, we found that rainfall became increasingly irregular and unpredictable. With the high variability in recent years, a shift in dominant contributing meteorological factors was also observed. An increase in model error (RMSE) in later years indicated growing climate instability.

4.3 Model Insights

Linear Regression clearly captured the temperature rise, and the random forest showed a decreasing predictive power of rainfall over time. Changes in feature importance reflected evolving weather dynamics.

5 Conclusion

The analysis provided clear evidence of **climate change impacts in Manipal**, including rising average temperatures, increased rainfall unpredictability, and shifting meteorological influence patterns.

These changes reflect the immediate need for long-term climate monitoring and climate-aware infrastructure development.