

# Weather and Climate Trends in Manipal

## 1 Introduction

Manipal, located in the coastal region of Karnataka, experiences a tropical climate characterized by moderate to heavy precipitation during the monsoon season and relatively stable temperatures throughout the year. Understanding the seasonal patterns and long-term climate trends is crucial for urban planning, agriculture, and water resource management.

This report analyzes the seasonality of precipitation and climate change trends for both temperature and precipitation in Manipal using historical observations.

## 2 Seasonal Patterns of Precipitation

### Observations:

- Precipitation remains very low from January to May and from October to December (approximately 0–50 mm).
- There is a sharp increase in precipitation from June to September, peaking in July and August (approximately 800–900 mm), which corresponds to the monsoon season.
- This pattern indicates a highly seasonal climate, with almost all annual rainfall concentrated in the monsoon months.
- The shaded area around the line indicates variability in monthly precipitation, suggesting occasional fluctuations in monsoon intensity.

**Insight:** Manipal experiences a classic monsoonal precipitation pattern with distinct wet and dry seasons.

## 3 Climate Change Trend: Temperature

### Observations:

- The black dots represent observed annual average temperatures, showing small interannual fluctuations.
- The red line shows the trend line, with a slope of  $0.0625^{\circ}\text{C}$  per year, indicating a gradual warming trend.

- This corresponds to a temperature increase of approximately  $1.25^{\circ}\text{C}$  over 20 years, reflecting the effects of climate change on the region.

**Insight:** Average temperatures in Manipal are steadily rising, highlighting a warming climate trend consistent with global patterns.

## 4 Climate Change Trend: Precipitation

### Observations:

- Annual precipitation varies significantly from year to year, reflecting interannual variability in monsoon intensity.
- The trend line indicates a small increase in precipitation by 1.6226 units/year (likely mm per year).
- Though the trend is positive, variability is high, and no extreme long-term increase is immediately apparent.

**Insight:** Precipitation shows a slightly increasing trend, but high interannual variability suggests monsoon fluctuations dominate year-to-year rainfall changes.

## 5 Key Insights

- **Seasonality:** Manipal has a pronounced monsoon season (June–September), with minimal rainfall outside this period.
- **Warming Trend:** Average annual temperatures are increasing at  $0.0625^{\circ}\text{C}$  per year, a clear signal of climate warming.
- **Rainfall Trend:** Annual precipitation shows a slight increasing trend, though variability is high.
- **Climate Implications:** Rising temperatures combined with monsoon-dependent rainfall could impact water resources, agriculture, and urban infrastructure.

## 6 Conclusion

The analysis of Manipal’s weather patterns indicates that while the monsoon continues to dominate precipitation, temperatures are gradually rising, consistent with broader climate change trends. Long-term monitoring and climate adaptation strategies are recommended to mitigate potential impacts on the region.