National River Conservation Directorate
Ministry of Jal Shakti,
Department of Water Resources,
River Development & Ganga Rejuvenation
Government of India

Climatological and Meteorological Status of Godavari River Basin

May 2025

Climatological and Meteorological Status of Godavari River Basin

National River Conservation Directorate (NRCD)

The National River Conservation Directorate, functioning under the Department of Water Resources, River Development & Ganga Rejuvenation, and Ministry of Jal Shakti providing financial assistance to the State Government for conservation of rivers under the Centrally Sponsored Schemes of 'National River Conservation Plan (NRCP)'. National River Conservation Plan to the State Governments/ local bodies to set up infrastructure for pollution abatement of rivers in identified polluted river stretches based on proposals received from the State Governments/ local bodies.

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Centres for Godaveri River Basin Management and Studies (cGodavari)

The Center for Godavari River Basin Management and Studies (cGodavari) is a Brain Trust dedicated to River Science and River Basin Management. Established in 2024 by CSIR-NEERI and IIT Hyderabad, under the supervision of cGanga at IIT Kanpur, the center serves as a knowledge wing of the National River Conservation Directorate (NRCD). cGodavari is committed to restoring and conserving the Godavari River and its resources through the collation of information and knowledge, research and development, planning, monitoring, education, advocacy, and stakeholder engagement.

www.cGodavari.org

Centres for Ganga River Basin Management and Studies (cGanga)

cGanga is a think tank formed under the aegis of NMCG, and one of its stated objectives is to make India a world leader in river and water science. The Centre is headquartered at IIT Kanpur and has representation from most leading science and technological institutes of the country. cGanga's mandate is to serve as think-tank in implementation and dynamic evolution of Ganga River Basin Management Plan (GRBMP) prepared by the Consortium of 7 IITs. In addition to this, it is also responsible for introducing new technologies, innovations, and solutions into India.

www.cganga.org

Acknowledgment

This report is a comprehensive outcome of the project jointly executed by CSIR-NEERI (Lead Institute) and IIT Hyderabad (Fellow Institute) under the supervision of cGanga at IIT Kanpur. It is submitted to the National River Conservation Directorate (NRCD) in 2024. We gratefully acknowledge the individuals who provided information and photographs for this report.

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Preface

In an era of unprecedented environmental change, understanding our rivers and their ecosystems has never been more critical. This report aims to provide a comprehensive overview of our rivers, highlighting their importance, current health, and the challenges they face. As we explore the various facets of river systems, we aim to equip readers with the knowledge necessary to appreciate and protect these vital waterways.

Throughout the following pages, you will find an in-depth analysis of the principles and practices that support healthy river ecosystems. Our team of experts has meticulously compiled data, case studies, and testimonials to illustrate the significant impact of rivers on both natural environments and human communities. By sharing these insights, we hope to inspire and empower our readers to engage in river conservation efforts.

This report is not merely a collection of statistics and theories; it is a call to action. We urge all stakeholders to recognize the value of our rivers and to take proactive steps to ensure their preservation. Whether you are an environmental professional, a policy maker, or simply someone who cares about our planet, this guide is designed to support you in your efforts to protect our rivers.

We extend our heartfelt gratitude to the numerous contributors who have generously shared their stories and expertise. Their invaluable input has enriched this report, making it a beacon of knowledge and a practical resource for all who read it. It is our hope that this report will serve as a catalyst for positive environmental action, fostering a culture of stewardship that benefits both current and future generations.

As you delve into this overview of our rivers, we invite you to embrace the opportunities and challenges that lie ahead. Together, we can ensure that our rivers continue to thrive and sustain life for generations to come.

Centre for the Godavari River Basin
Management and Studies (cGodavari)
CSIR-NEERI, IIT Hyderabad

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Abbreviations

CPCB	Central Pollution Control Board
NASA	National Aeronautics and Space Administration
GCM	Global Climate Models
RCM	Regional Climate Models
RH	Relative Humidity
AT	Air Temperature
WS	Wind Speed
WD	Wind Direction
SR	Solar Radiation
RF	Rain Fall / precipitation
SPEI	Standard Precipitation Evapotranspiration Index

1 Introduction

Climatology and meteorology data are essential for understanding atmospheric conditions and their impact on water resources. Climatology examines long-term weather patterns, while meteorology focuses on short-term variations. These datasets influence the hydrological cycle by determining precipitation, evaporation, and temperature trends, which in turn affect river flows, groundwater recharge, and overall water availability. In river basin management, accurate weather and climate data help predict floods, droughts, and seasonal water distribution, ensuring sustainable allocation for agriculture, industry, and domestic use.

In water resource management, these data sets are crucial for infrastructure planning, disaster preparedness, and maintaining water quality. Flood forecasting, drought prediction, and reservoir management depend on real-time meteorological observations and long-term climate trends. Additionally, climate change impacts, such as shifting rainfall patterns and rising temperatures, affect water availability and ecosystem health, making it essential to integrate climatology and meteorology into adaptive water management strategies. Proper utilization of these data sources enhances decision-making for sustainable water use and resilience against climate variability.

The Godavari River Basin, one of India's largest river basins, spans multiple states and supports agriculture, drinking water supply, hydropower, and industry. Studying climatology and meteorology in this basin is crucial due to its dependence on monsoon rainfall, which varies annually and affects water availability. Understanding long-term climate patterns helps predict droughts, floods, and changing rainfall trends, ensuring better water resource management. Seasonal variations in precipitation and temperature also impact river flows, groundwater recharge, and agricultural productivity, making climate data vital for planning irrigation and water conservation strategies.

Additionally, climate change is altering rainfall distribution and increasing extreme weather events in the region. Accurate meteorological data supports early flood warning systems, reservoir operation planning, and disaster risk reduction to minimize damages from monsoon floods. With growing water demands from agriculture, industry, and urbanization, integrating climate and weather studies into basin management ensures sustainable water allocation and ecosystem protection. Studying climatology and meteorology in the Godavari River Basin is essential for long-term water security, climate resilience, and informed policy-making.

Interpreting climatology and meteorology data in a river basin like the Godavari River Basin involves analyzing various parameters to assess their impact on water availability, flood risks, and ecosystem sustainability. Rainfall data is crucial, as it determines river flow and groundwater recharge. By studying historical precipitation trends, seasonal variations, and extreme rainfall events, water managers can predict droughts, floods, and monsoon behavior, helping in reservoir management and agricultural planning. Temperature data is used to estimate evaporation rates, snow melt contributions (if applicable), and overall water demand, aiding in long-term water balance assessments.

Hydrological models integrate meteorological inputs such as precipitation, temperature, humidity, and wind speed to simulate river flow, runoff, and groundwater movement. Satellite data and remote sensing help track land use changes, soil moisture, and vegetation cover, which influence basin hydrology. Statistical and GIS-based tools analyze spatial and temporal climate patterns to identify vulnerable areas prone to water scarcity or flooding. Real-time meteorological observations further support early warning systems, enabling proactive decision-making for flood control, irrigation scheduling, and drought mitigation. Proper interpretation of these datasets ensures sustainable water resource management, climate resilience, and efficient planning in the basin.

The following sections elaborate the methodology and the analysis of the data

2 Meteorological data

The meteorological data in the basin are obtained from the monitoring network operated by the Central and State Pollution Control Boards. The locations of the monitoring sites in the Godavari River Basin were identified from the CPCB data portal, shown in Figure 1. The data from Hyderabad City also considered in the analysis as it is just outside the basin. From each monitoring site, the meteorological data consisting of solar radiation, temperature (maximum and minimum), wind speed and direction, rainfall, and relative humidity were downloaded. The daily-averaged data were analyzed and the time-series plots of the variables were plotted for visual interpretation of the data and to appreciate the seasonal variations in the values.

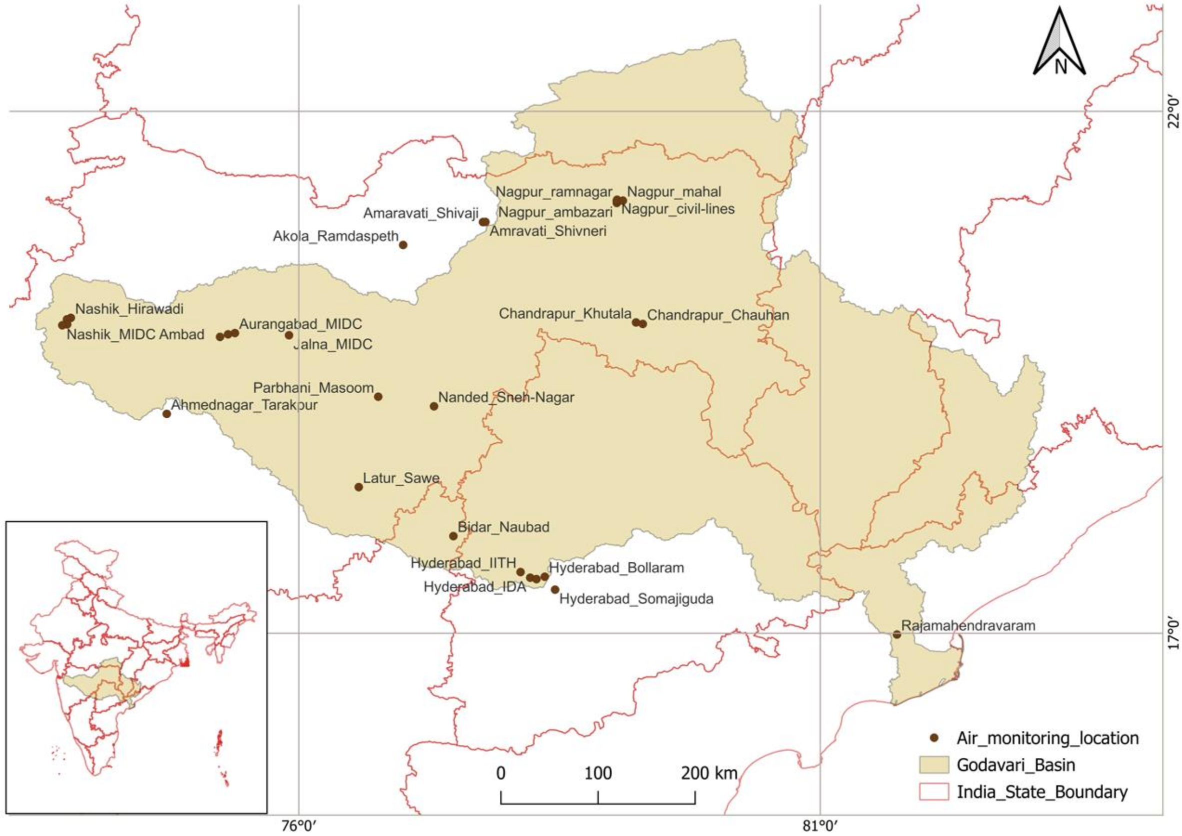

Figure 1 Location of CPCB monitoring sites in the basin

2.1 Solar Radiation

Solar radiation is the energy emitted by the sun in the form of electromagnetic waves, including visible light, ultraviolet (UV), and infrared (heat) radiation. It is the primary driver of the Earth's climate and hydrological cycle, influencing temperature, evaporation, and weather patterns. Solar radiation varies with latitude, altitude, season, and atmospheric conditions such as cloud cover and air pollution.

In a river basin like the Godavari River Basin, solar radiation plays a crucial role in evaporation rates, water temperature, and overall energy balance. Higher solar radiation increases evapotranspiration, affecting soil moisture, groundwater recharge, and river flow. Understanding solar radiation patterns helps in estimating crop water requirements for irrigation planning, optimizing reservoir management, and assessing climate change impacts on the basin. It is also essential for hydro-power generation and solar energy projects within the basin. By studying solar radiation, water resource planners can make informed decisions to ensure sustainable water management, agricultural productivity, and ecosystem health.

The data is retrieved from the CPCB archives for years starting from 2018 to 2024 (till September). The variable is measured in W/m^2. The monthly average of daily values from the CPCB monitoring stations in the basin and a few monitoring locations from the adjacent cities are plotted in Figure 2. The monthly average values describe the seasonal variation in the data, shown in Figure 3.

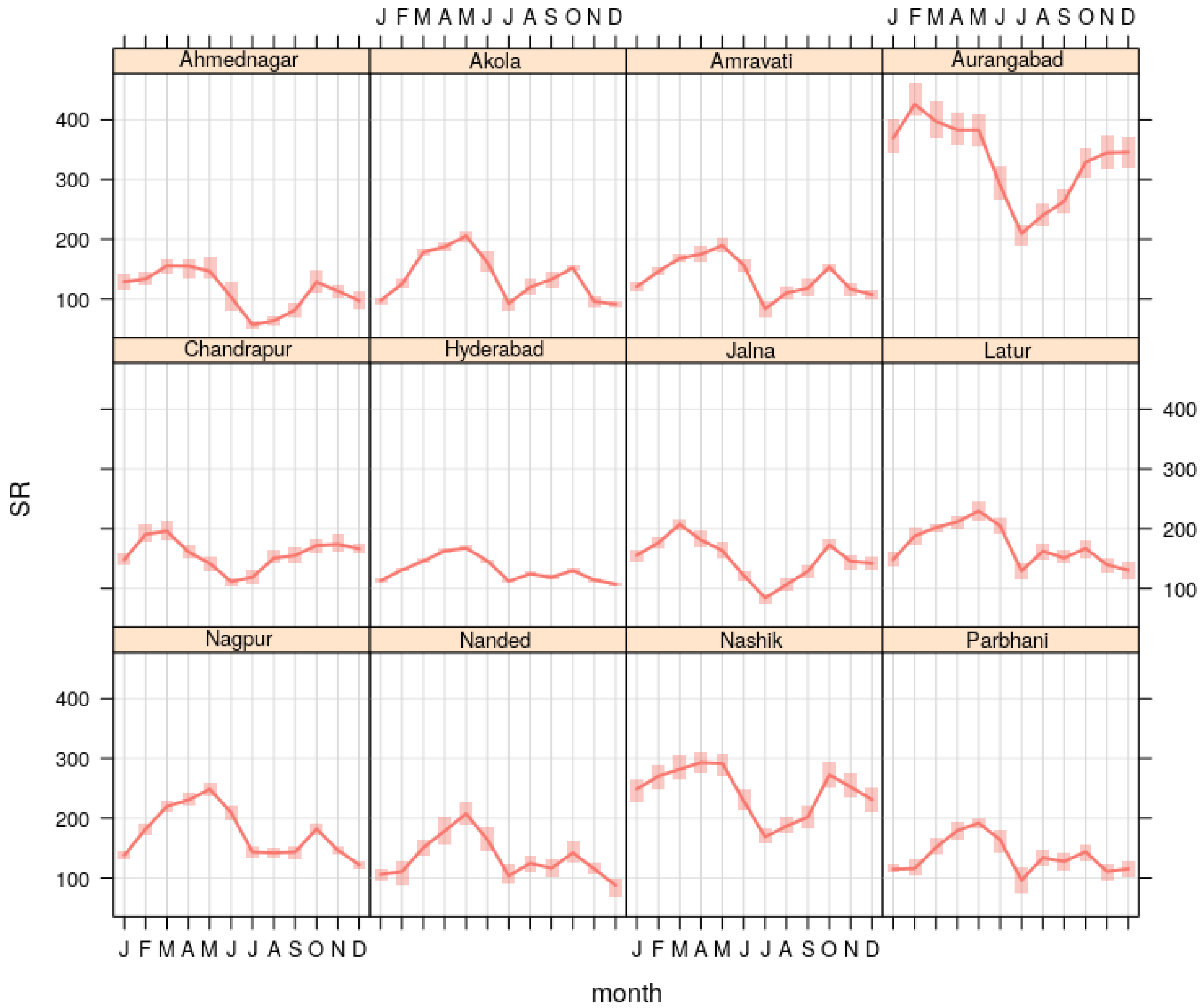

Figure 2 Monthly average solar radiation (W/m^2) in the cities considered in the study (data source: CPCB)

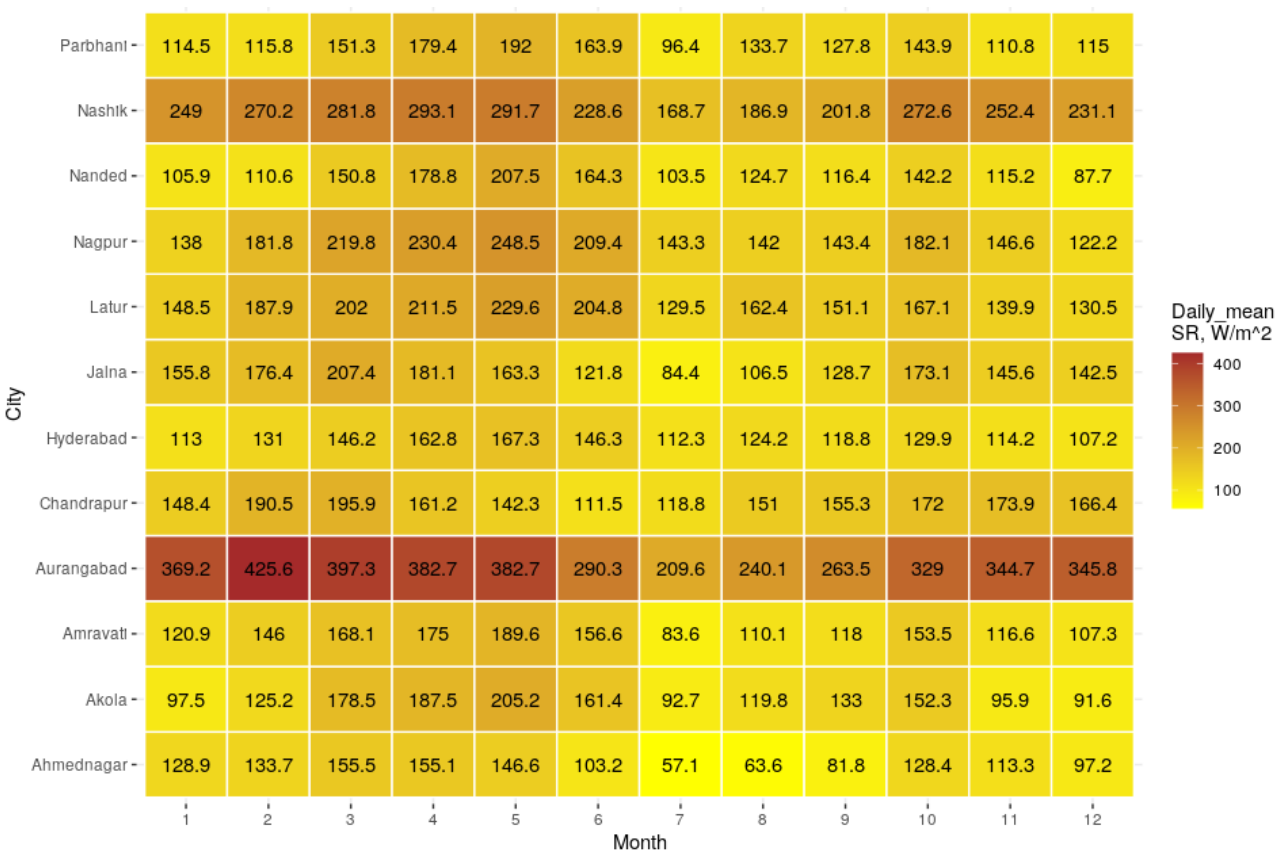

Figure 3 Heatmap of the Monthly average solar radiation (W/m2) in the cities considered in the study (data source: CPCB)

2.2 Temperature

In a river basin like the Godavari River Basin, temperature variations significantly impact hydrology, agriculture, and water resource management. High temperatures increase evaporation and evapotranspiration, affecting soil moisture, reservoir levels, and water availability. Extreme temperatures also influence river water temperature, which affects aquatic ecosystems, fish populations, and water quality.

Studying temperature trends helps in predicting droughts, managing irrigation demand, and assessing climate change impacts on the basin. Rising temperatures can lead to increased water stress and altered monsoon patterns, affecting river flow and groundwater recharge. Understanding daily temperature variations is essential for flood forecasting, hydro-power generation, and long-term water resource planning in the basin.

2.3 Temperature (daily Mean)

The data is retrieved from the CPCB archives for years starting from 2017 to 2024 (till September). The multiple trends in the daily average ambient temperature (AT) for different cities considered in the study are plotted in Figure 4. The monthly average values are presented in the figure. The monthly averaged AT in the cities considered in the basin varied between 17.35 and 36.93 °C. Most cities show a seasonal temperature variation, the values peak in summer around April and May, and falls in winter around December and January. A noticeable drop in AT occurs around June and July during monsoon season. Most of the cities exhibit a sharp rise in the temperature from January to May, followed by a drop in monsoon and thereafter follows a gradual decline towards winter. Chandrapur, Akola, Nanded, Parbhani, and Jalna is observed to have relatively higher average peak temperatures in the basin during May. Nashik and Hyderabad (not in the basin, but adjacent) appear to have moderate average peak temperatures relative to other cities in the basin. The heatmap of the monthly average AT is provided in Figure 5 for easy interpretation of the data.

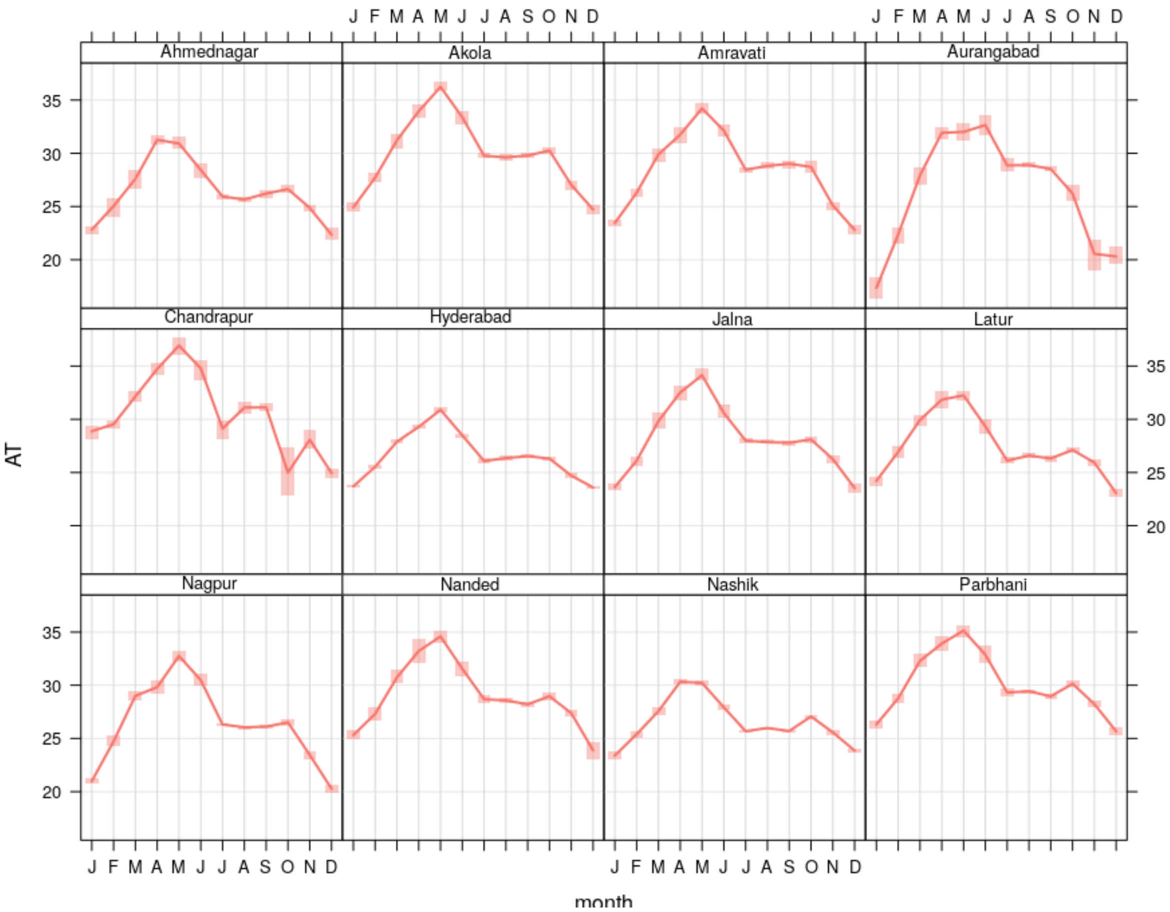

Figure 4 Monthly average air temperature (AT, in deg C) in the cities considered in the study (data source: CPCB)

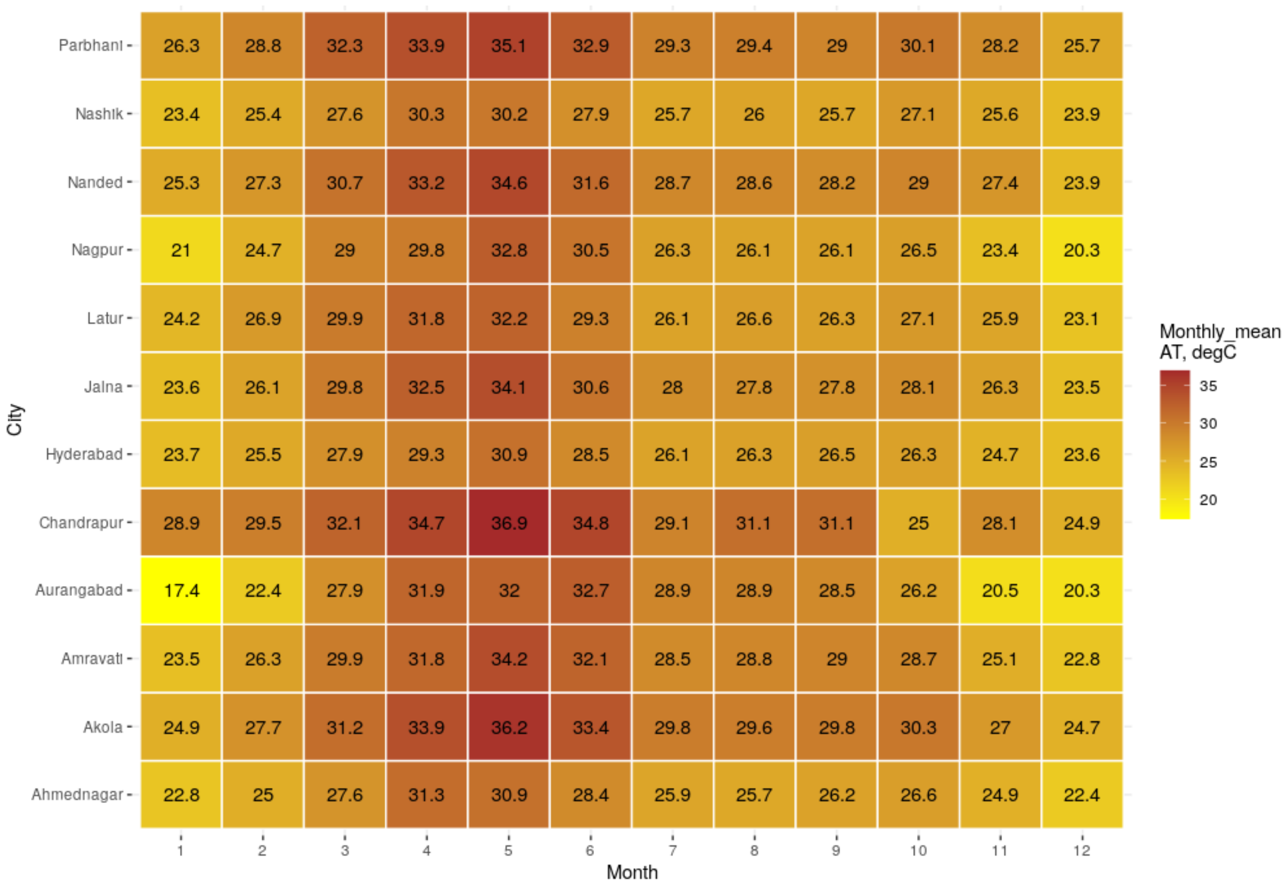

Figure 5 Heatmap of the Monthly average air temperature (°C) in the cities considered in the study (data source: CPCB)

2.4 Wind flow

Wind flow/wind velocity is a vector quantity having both speed and direction. The rate at which air moves in the atmosphere, usually measured in meters per second (m/s) or kilo meters per hour (km/h). Wind Direction: The direction from which the wind originates, typically expressed in degrees (e.g., 0° for north, 90° for east). In a river basin like the Godavari River Basin, wind speed and direction play a crucial role in evaporation, weather patterns, and water resource management. Strong winds increase evapotranspiration, reducing soil moisture and water levels in reservoirs and rivers. Wind patterns also influence monsoon circulation, affecting rainfall distribution and flood risks. Additionally, wind speed impacts wave action and sediment transport in reservoirs and rivers, affecting water quality and erosion patterns. It is also crucial for hydro-power generation, navigation, and early warning systems for extreme weather events such as cyclones. By analyzing wind patterns, water managers can improve climate resilience, optimize water use, and enhance disaster preparedness in the basin.

2.4.1 Wind speed

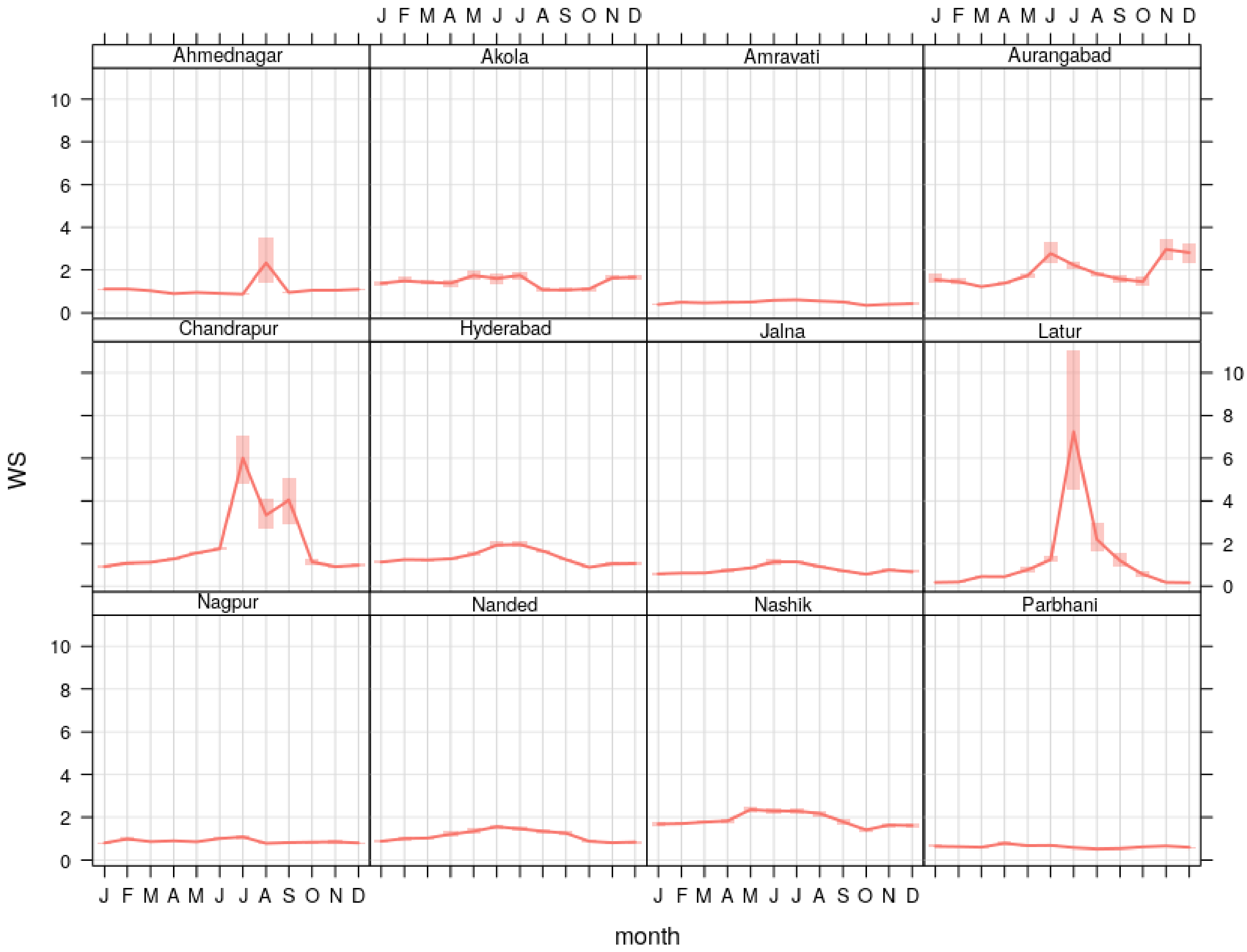

Figure 6 Monthly average wind speed (m/s) in the cities considered in the study (data source: CPCB)

The wind speed (WS) data obtained from CPCB for the cities considered in the study are plotted in Figure 6, which shows the monthly average values of the day-average WS data. The data for the cities considered in the study varied from 0.1705 to 7.2295 m/s. The wind speed values are typically higher in monsoon during June-August in almost all cities considered in the study. Particularly, the WS values are higher in Latur, followed by Chandrapur, Ahmednagar, and Aurangabad. In rest of the cities the monthly averaged wind speed in less than 2 m/s.

2.4.2 Wind direction

Analyzing both Wind direction and wind speed together through the help of windrose diagrams provides better understanding of the wind flow. In the present study, the monthly averaged wind speed and direction were considered for the select cities and plotted the windrose according to various seasons. The data are categorized into three seasons viz. Monsoon (June-September), post-monsoon (October-January), and pre-monsoon (February-May). The windrose data for the cities according to the seasons are presented in Figure 7, Figure 8, and Figure 9. Majority of the wind measured at the monitoring stations flows from southern and south-western direction during March to November. During winter the majority of the wind flows from south-eastern direction.

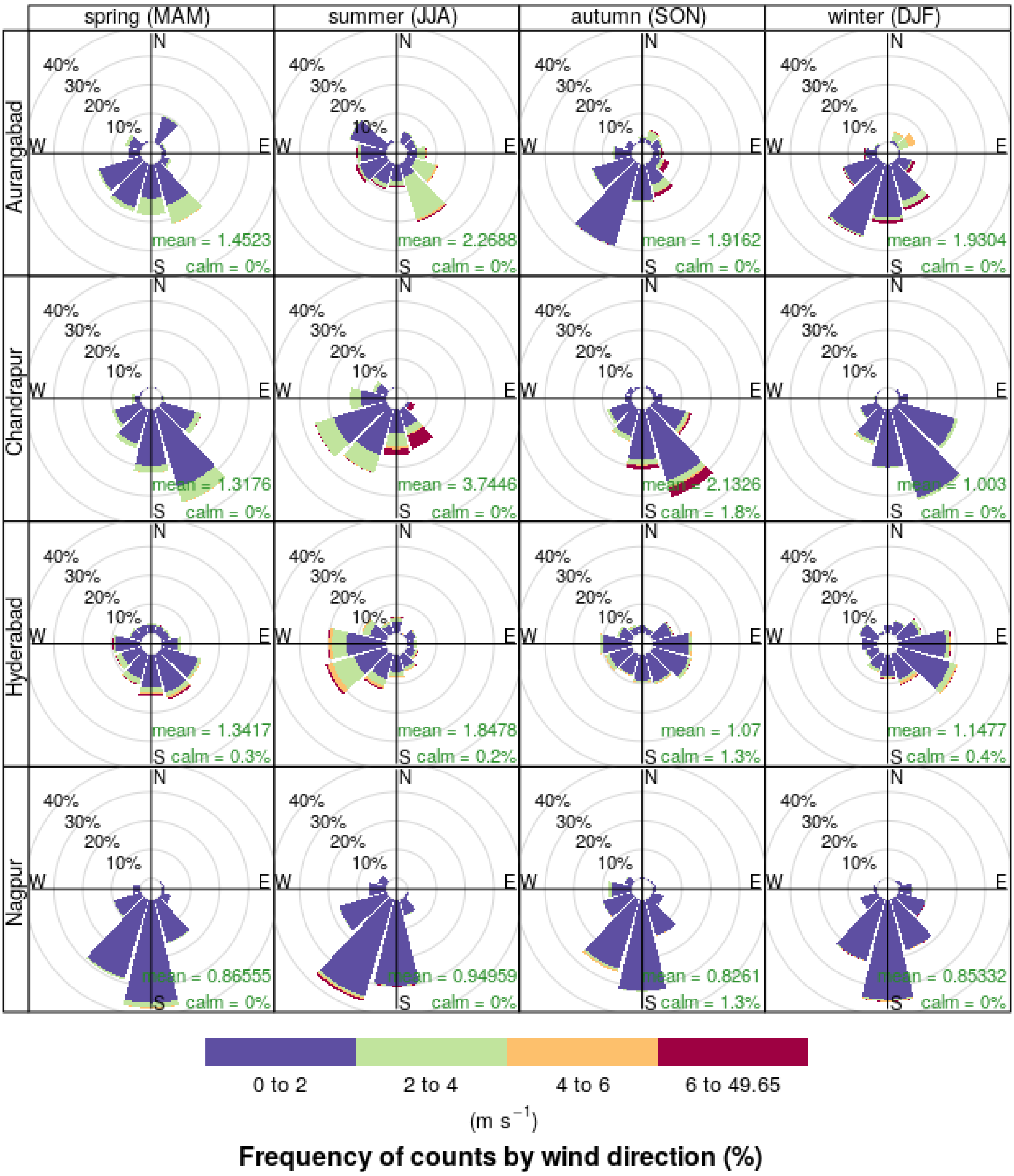

Figure 7 Monthly averaged windrose diagram for Aurangabad, Chandrapur, Hyderabad, and Nagpur cities (Source: CPCB)

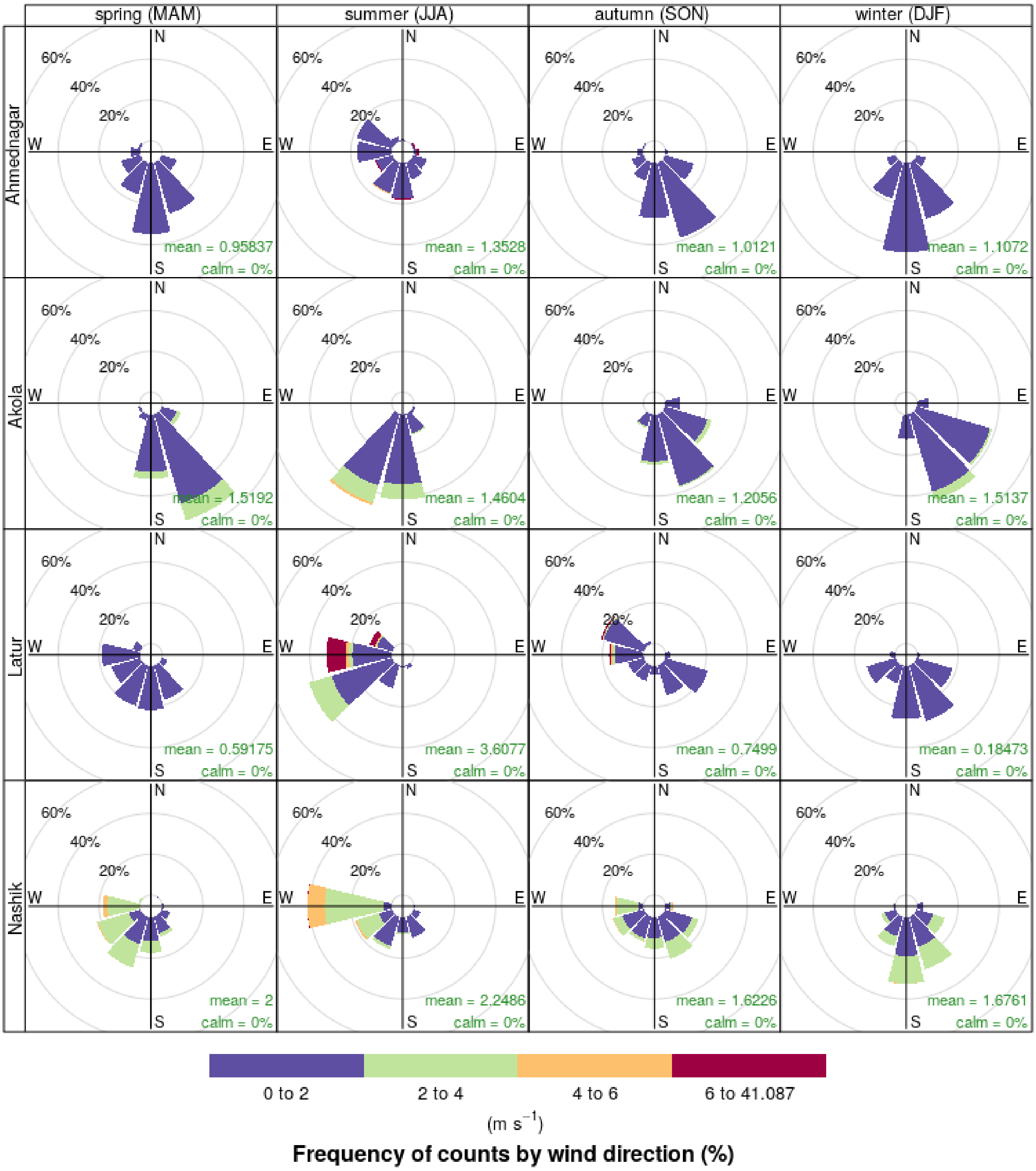

Figure 8 Monthly averaged windrose diagram for Ahmednagar, Akola, Latur, and Nashik cities (Source: CPCB)

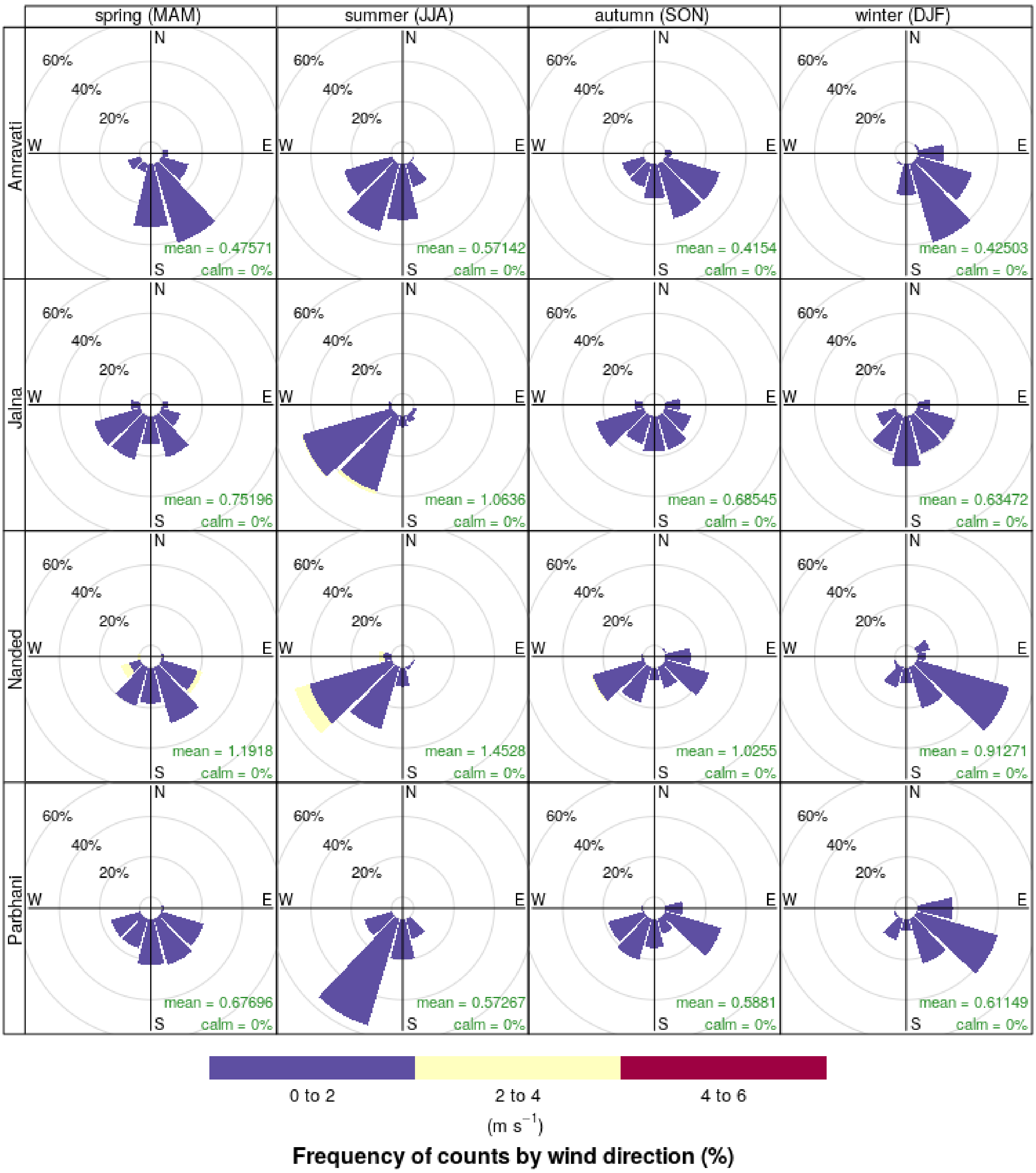

Figure 9 Monthly averaged windrose diagram for Amravati, Jalna, Nanded, and Parbhani cities (Source: CPCB)Cloud cover

2.5 Precipitation

Precipitation refers to any form of water—liquid or solid—that falls from the atmosphere to the Earth's surface. It includes rain, snow, sleet, and hail. Precipitation is a key component of the hydrological cycle, as it replenishes surface water bodies, groundwater, and soil moisture.

In a river basin like the Godavari River Basin, precipitation is the primary source of water for rivers, lakes, and reservoirs. Understanding precipitation patterns helps in water resource planning, flood control, and drought management. Uneven or extreme rainfall can cause flooding, soil erosion, and water-logging, while insufficient rainfall leads to droughts and water shortages.

Studying precipitation trends also supports agriculture, hydropower generation, and groundwater recharge. Seasonal variations, such as the monsoon cycle, greatly impact water availability and require careful management to ensure sustainable water use. Accurate precipitation data is essential for forecasting extreme weather events, designing efficient irrigation systems, and maintaining ecosystem health in the basin.

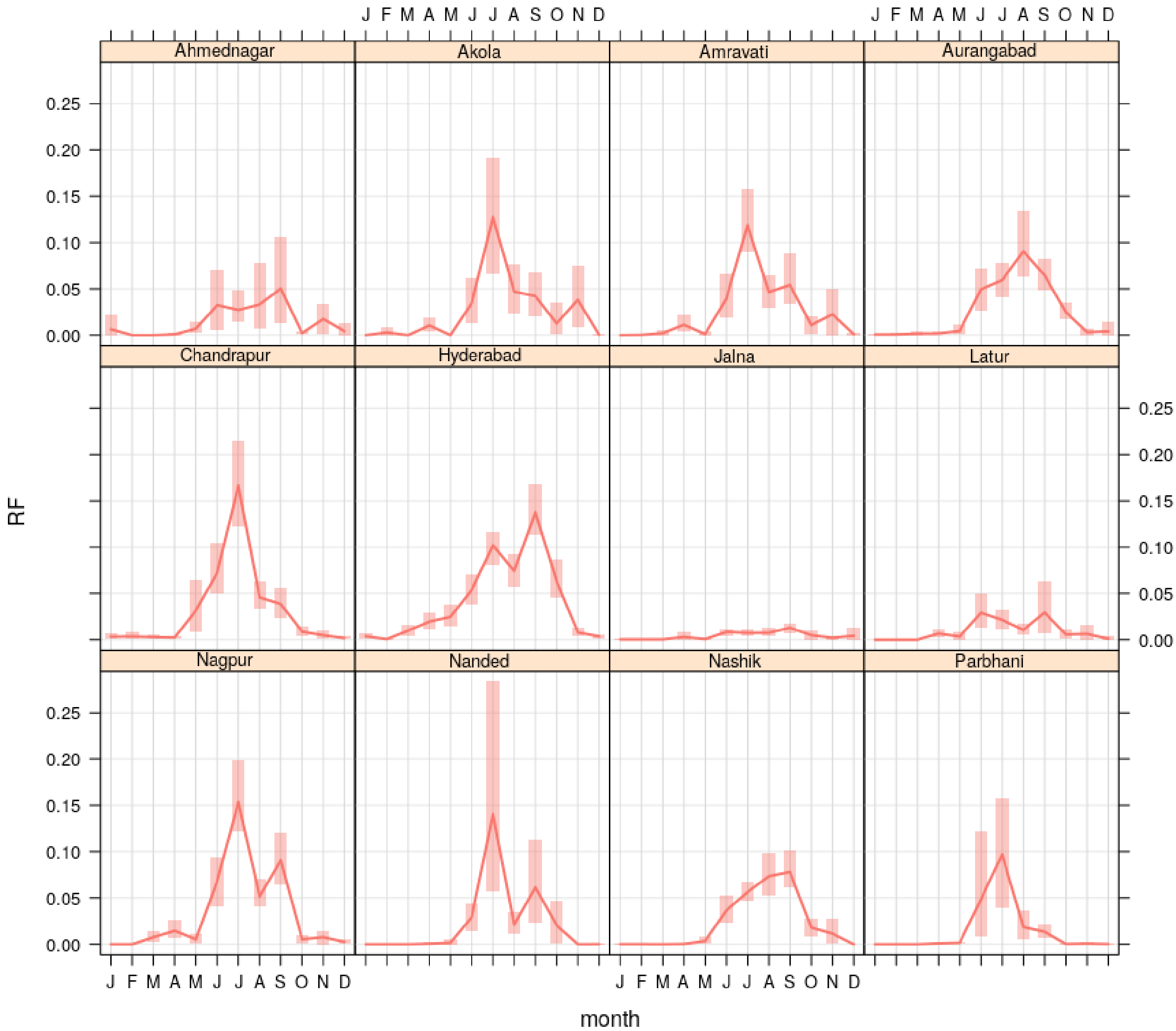

Figure 10 Monthly average Rainfall (mm) in the cities considered in the study (data source: CPCB)

The daily-averaged RF values varied from 0 to 5.9 mm in the cities considered in the study. Figure 10 represents the monthly averaged rainfall (RF, mm) trends across various cities in the Godavari Basin. The trends follow a distinct monsoon peaks during June to September. Almost all cities experience a sharp rise in RF peaking around July-August, and declining in September-October. This trends noticed is a characteristic of south-west monsoon, which dominates the rainfall pattern in the basin. Very little or no-rainfall (dry season) is observed in winter (November-February) and summer (March-May) in the basin, with small spikes in May (pre-monsoon) seasons due to convective rainfalls or thunderstorms. Higher intensity rainfalls are reported from Chandrapur, Hyderabad, Nanded, Nagpur, and Akola. The data shows that Jalna and Latur receives quite low rainfall compared to other cities.

2.6 Relative Humidity

Relative humidity (RH) is the amount of moisture in the air compared to the maximum moisture the air can hold at a given temperature, expressed as a percentage. Higher RH indicates more moisture in the air, while lower RH suggests dry conditions. In a river basin like the Godavari River Basin, relative humidity plays a crucial role in evaporation, precipitation, and water balance. High humidity levels can reduce evaporation rates, helping to maintain soil moisture and reservoir storage, which is beneficial for agriculture. Conversely, low humidity accelerates evapotranspiration, leading to water loss from soil, rivers, and lakes, increasing the risk of drought and crop stress. Relative humidity also affects cloud formation and rainfall patterns, influencing the monsoon cycle and water availability in the basin. Additionally, it impacts fog formation, human comfort, and ecosystem health. Monitoring RH helps in weather forecasting, climate modelling, and optimizing irrigation strategies to ensure sustainable water management in the river basin.

The data shows that the monthly averaged RH values in the cities varies between 28.12 and 84.27%. The monthly average values are plotted in Figure 11. Results show that RH follows an inverse relationship with air temperature. RH is lowest in summer (March-May) around 30-50%, during which AT peaks. Latur, Nashik, Aurangabad, and Nanded have the lowest RH values in the range of 30-40% during summer, relative to other cities in the study. RH is the highest during monsoon (June-September/October) due to increased moisture in the atmosphere. Further, RH moderately rises again during winter (November-January) as the temperature drops. The peak RH values reach around 70-80% in monsoon months.

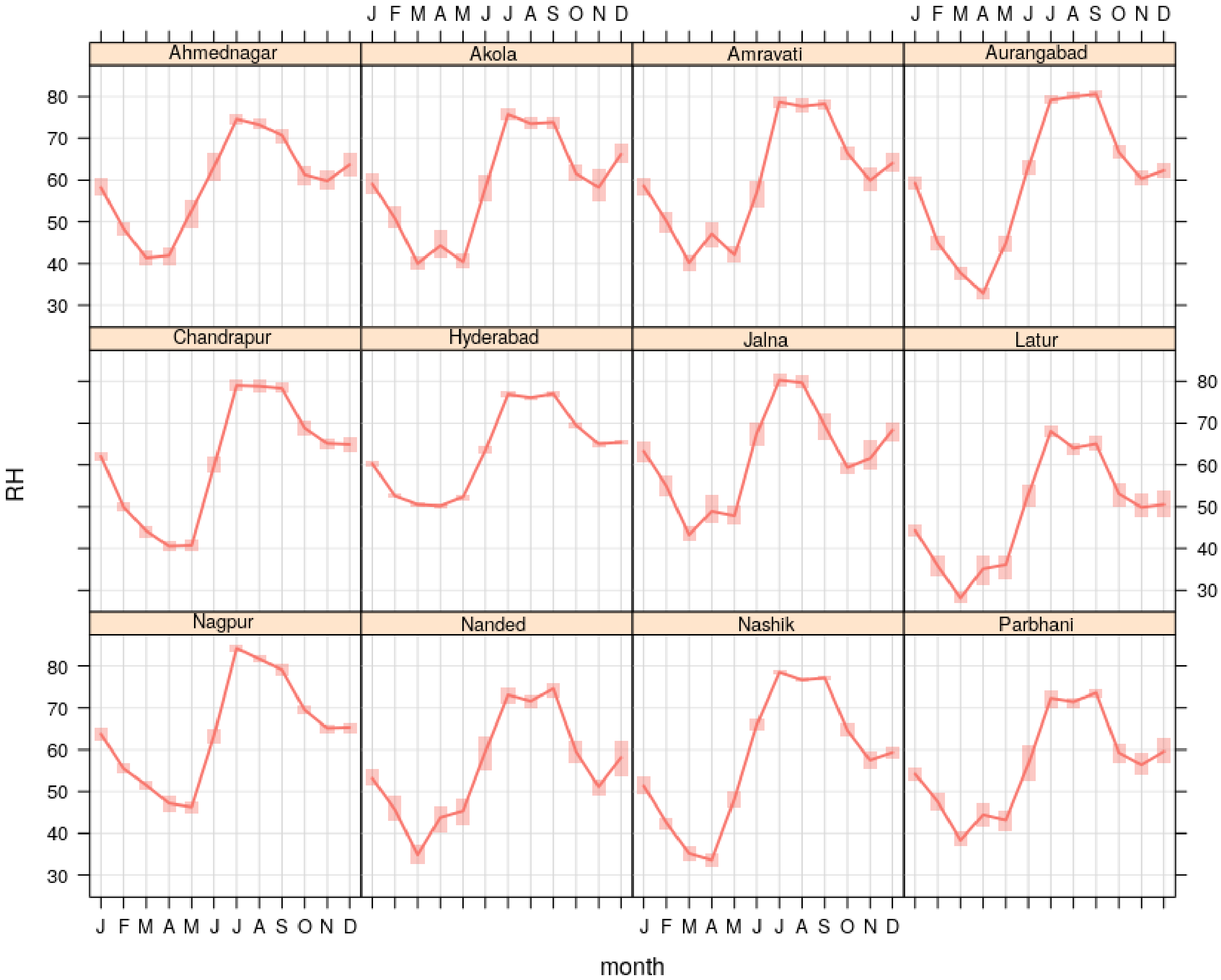

Figure 11 Monthly average Relative Humidity (%) in the cities considered in the study (data source: CPCB)

3 Collection of different GCMs and RCMs data

The Global Climate Model (GCM) data obtained from NASA CMIP6 project on a coarser grid were also analysed to appreciate the spatial variation and continuity in the variables. The GCM considered in the present study is ACCESS-CM2. The purpose of this section is to understand the historical, present and future trends in the changes in the climatic variables (Maximum surface temperature and precipitation) in the basin. This increases our understanding on the spatial and temporal shifts in the general climate patterns and the related hydrological processes. To some extent the analysis helps in studying the frequency of extreme weather events like high-intensity precipitations, and urban floods, and heatwaves.

3.1 Precipitation spatial data

3.1.1 GCM Precipitation data in historical period (1950-2014)

Precipitation data obtained from the CMIP-6 model simulations during 1950 to 2014 shows that the yearly maximum of the daily-mean precipitation rate (kg/m^2/s) increased significantly in the northern and south-eastern parts of the basin. The spatial trends in the precipitation intensity for various years in the study duration is shown in Figure 12.

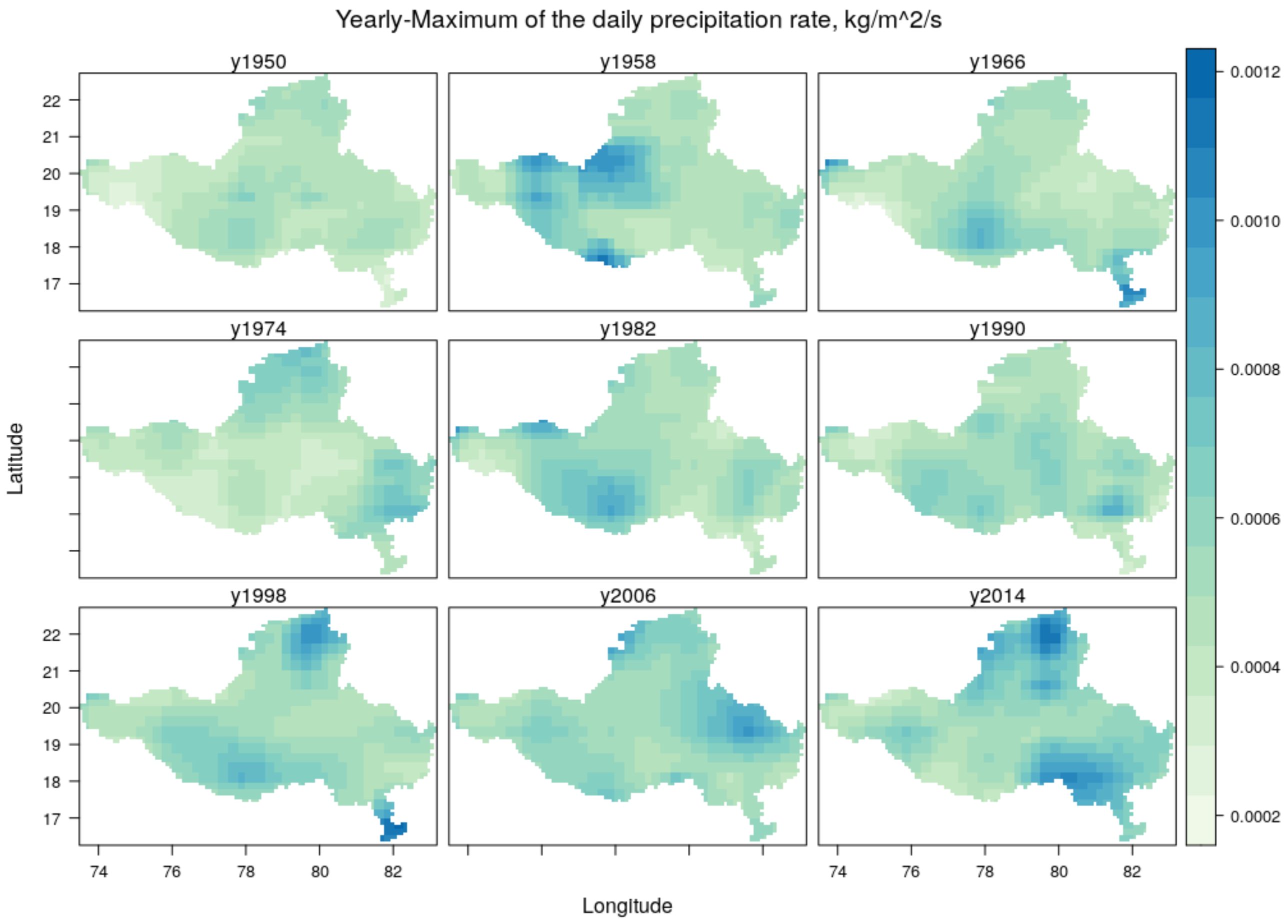

Figure 12 Yearly maximum of the daily-mean precipitation rate (kg/m^2/s) in the basin for several years during 1950-2014 (Source: NASA-GDDP-CMIP6). The values are simulation output of ACCESS-CM2 model

3.1.2 GCM Precipitation data in near future (2015-2050)

The near future duration 2015-2050 is considered in the study for capturing the spatial trends in the precipitation data. Two future climate change scenarios viz. Shared Socioeconomic Pathways (SSPs)-245 and SSP-585 were considered in the present report. These two scenarios SSP-245 and SSP-585 represent the benign and harsh climatic scenarios, respectively.

3.1.2.1 SSP-245 Scenario

The precipitation trends in the basin for 2015-2050 in SSP-245 are presented in Figure 13. Data shows that the yearly-maximum high-intensity rainfall events are expected to be concentrated more towards north-eastern, north-western, and southern parts of the basin from 2030s.

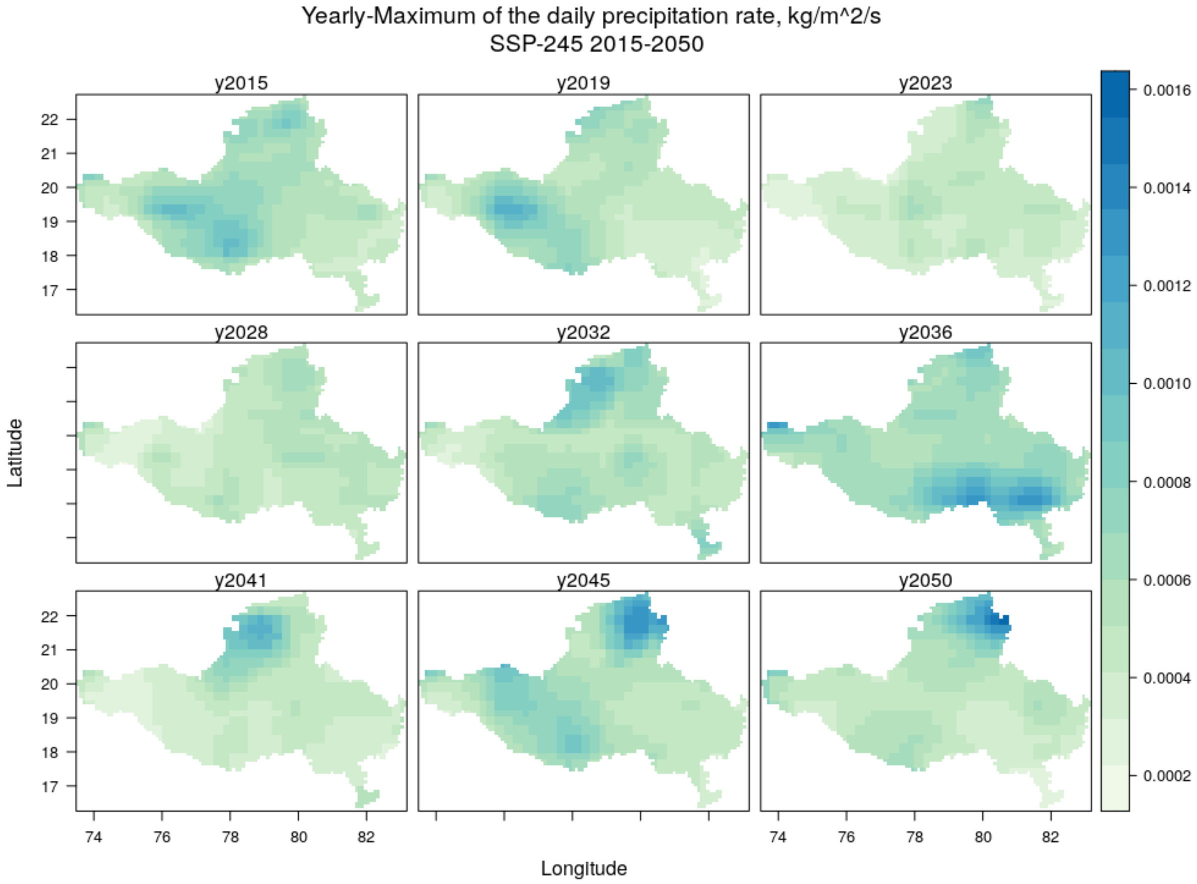

Figure 13 Yearly maximum of the daily-mean precipitation rate (kg/m^2/s) in the basin for several years during 2015-2050 for the scenario SSP-245 (Source: NASA-GDDP-CMIP6). The values are simulation output of ACCESS-CM2 model

3.1.2.2 SSP-585 Scenario

The precipitation trends in the basin for 2015-2050 in SSP-585 are presented in Figure 14. Data shows that the yearly-maximum high-intensity rainfall events are expected to be concentrated more towards south and south-eastern parts of the basin, also in the central zone of the basin. The spatial patterns in the precipitation intensity in SSP-585 is not similar to that of SSP-245.

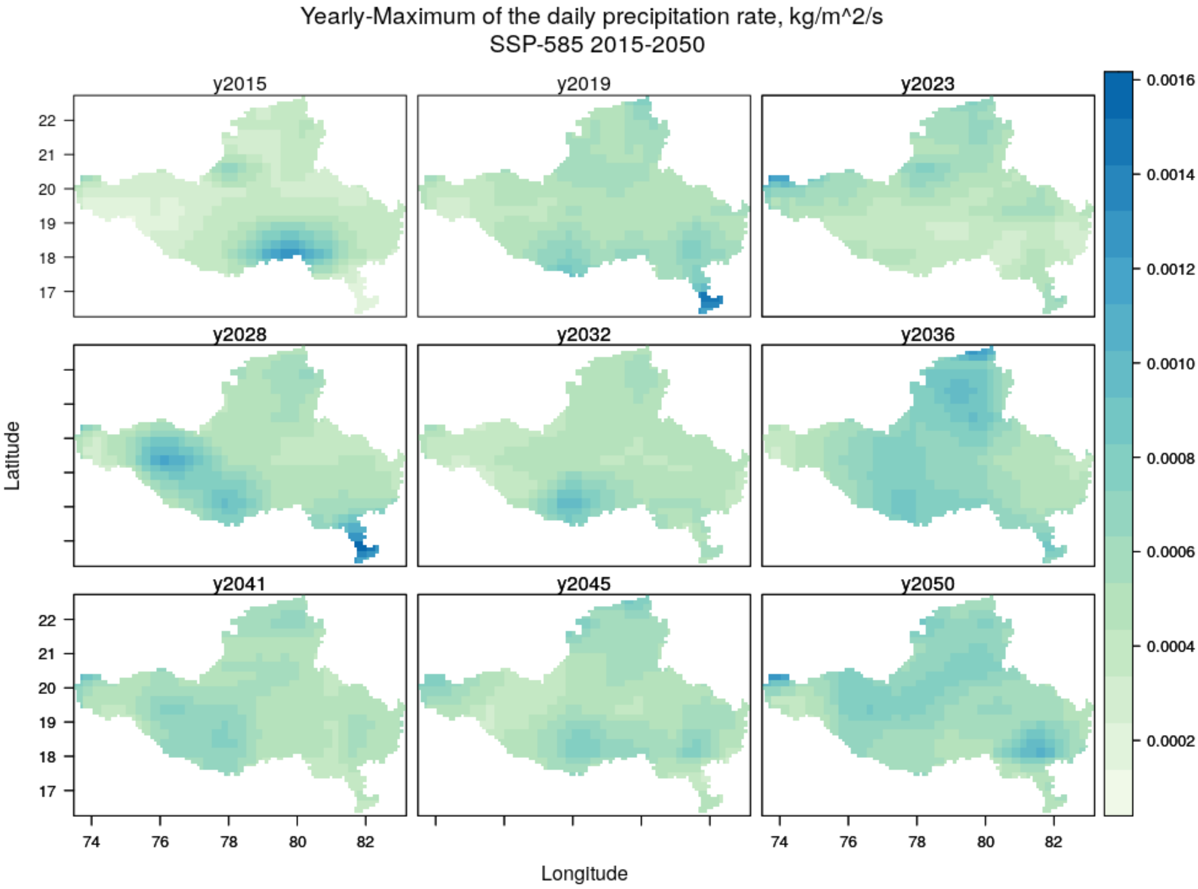

Figure 14 Yearly maximum of the daily-mean precipitation rate (kg/m^2/s) in the basin for several years during 2015-2050 for the scenario SSP-585 (Source: NASA-GDDP-CMIP6). The values are simulation output of ACCESS-CM2 model

3.1.3 GCM Precipitation data in far future (2051-2100)

Similar to the near-future analysis, the far-future trends in the spatial patterns of yearly maximum daily precipitation intensity data during 2051 to 2100 was analysed in the basin. Two scenarios SSP-245 and SSP-585 were considered.

3.1.3.1 SSP-245 Scenario

The precipitation trends in the basin for 2051-2100 in SSP-245 are presented in Figure 15. The data shows that the yearly-maximum high-intensity rainfall events are expected to be concentrated more towards north, north-western, and eastern parts of the basin.

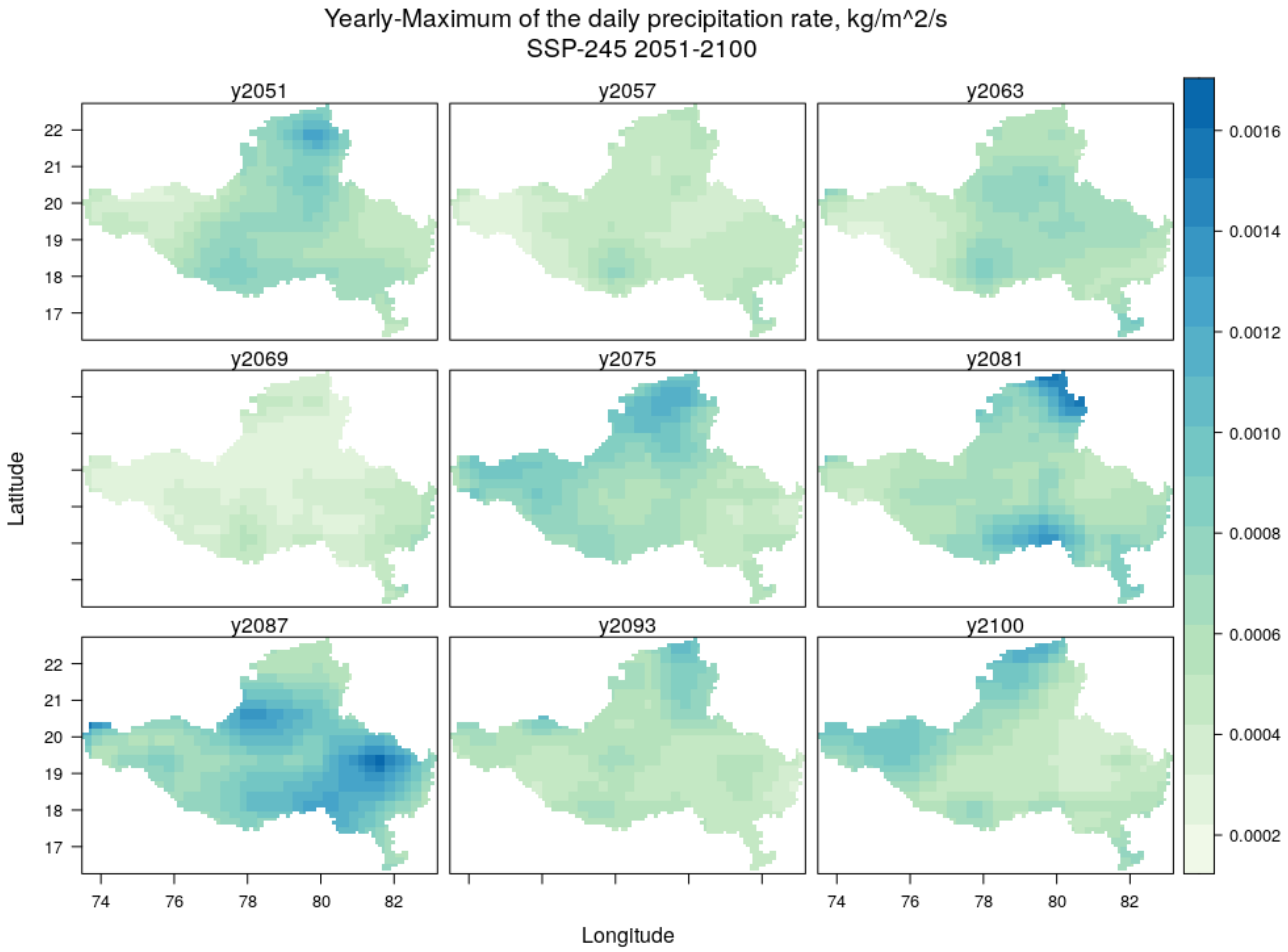

Figure 15 Yearly maximum of the daily-mean precipitation rate (kg/m^2/s) in the basin for several years during 2051-2100 for the scenario SSP-245 (Source: NASA-GDDP-CMIP6). The values are simulation output of ACCESS-CM2 model

3.1.3.2 SSP-585 Scenario

The precipitation trends in the basin for 2051-2100 in SSP-585 are presented in Figure 16. Data shows that the yearly-maximum high-intensity rainfall events are expected to be concentrated more towards north-western and south-eastern of the basin.

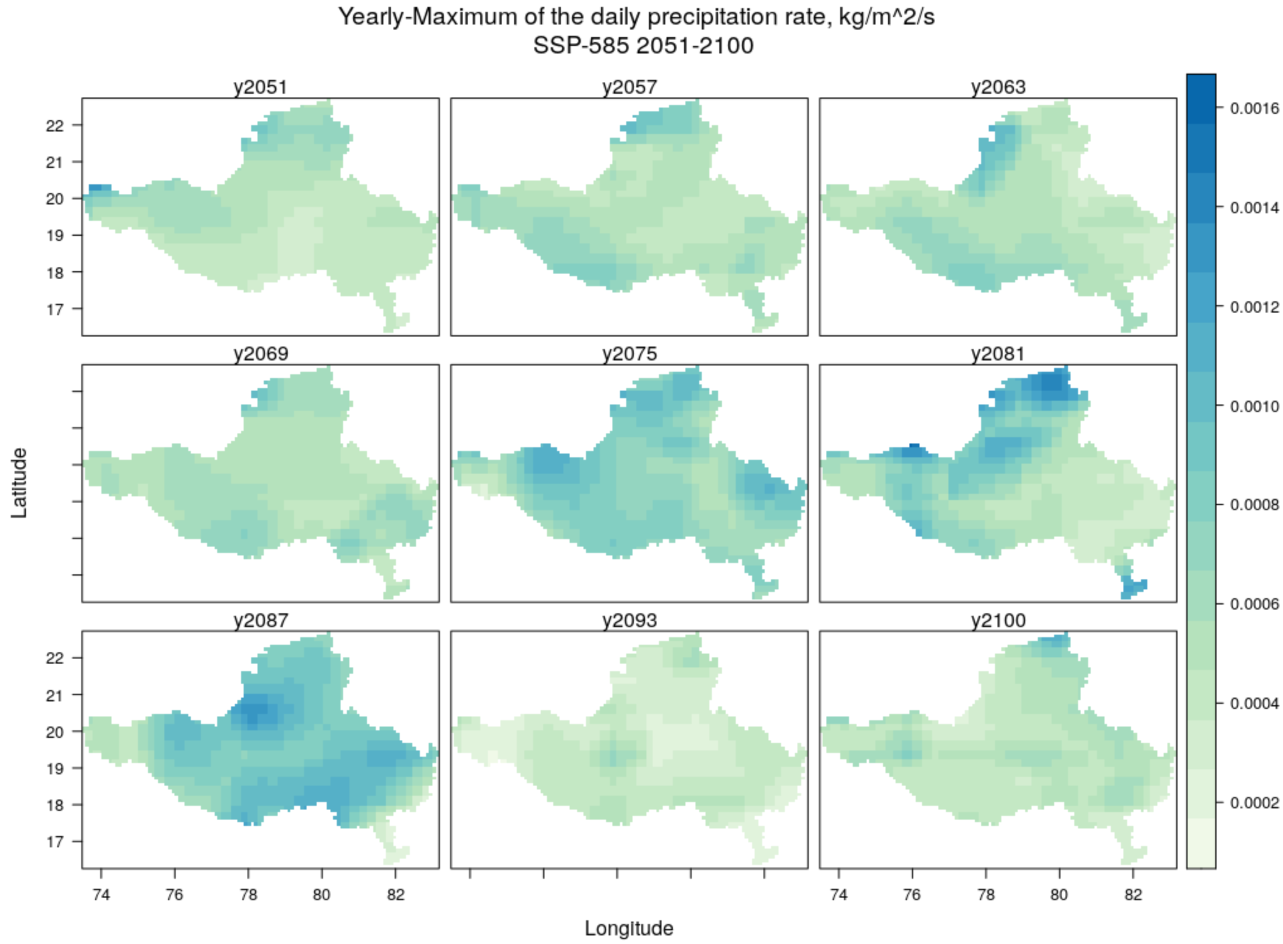

Figure 16 Yearly maximum of the daily-mean precipitation rate (kg/m^2/s) in the basin for several years during 2051-2100 for the scenario SSP-585 (Source: NASA-GDDP-CMIP6). The values are simulation output of ACCESS-CM2 model

3.1.4 Time-series of Yearly-maximum Precipitation

The time-series of the basin average (spatial-average) of the yearly-maximum precipitation intensity is plotted in Figure 17. The data shows the historical trend in the precipitation intensity during 1950-2014, followed by the future simulated precipitation intensity values for two scenarios SSP-245 and SSP-585. Analysis shows that the basin average yearly-maximum precipitation intensity is expected to increase in the near and far-future in general, however, the rise is more in SSP-585 compared to that of SSP-245. The precipitation intensity is set to increase in harsh climate change scenario compared to the benign one. At the whole basin level, even a slight change in the precipitation intensity could results in shifts in the hydrological behaviour of the basin and river flows. High frequent and high-intensity floods are more susceptible in the sub-basins with increased precipitation rates.

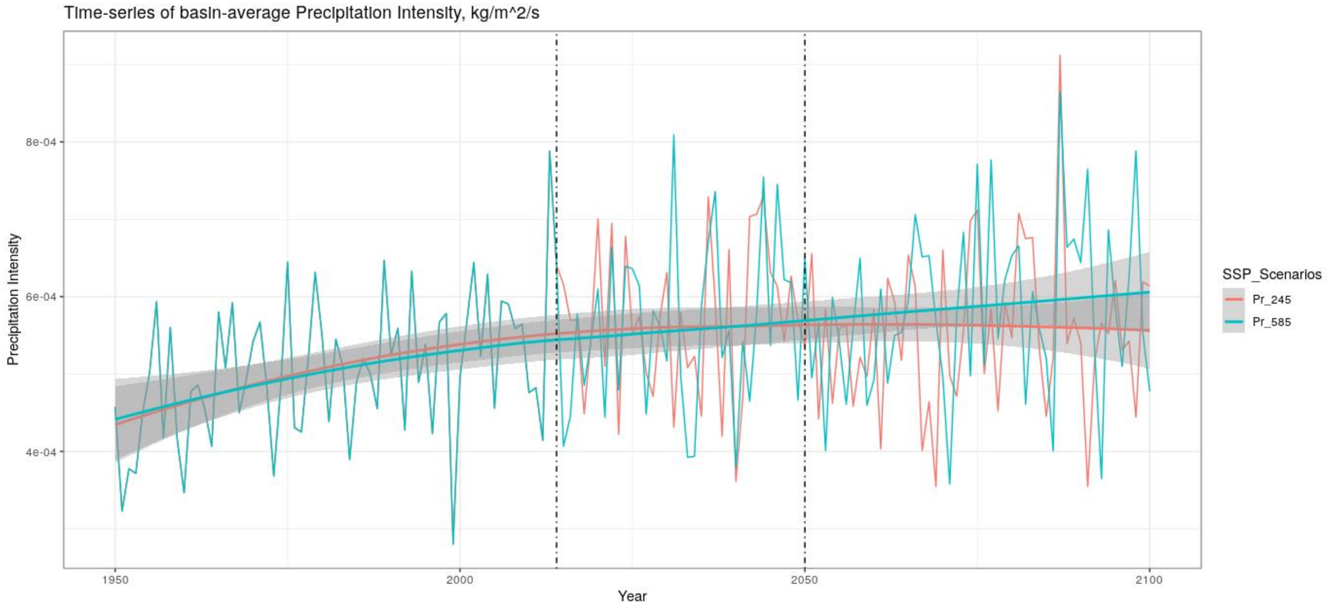

Figure 17 Time-series of the basin-average precipitation intensity (kg/m^2/s) from 1950 to 2100 for two different SSP scenarios SSP-245 and SSP-585 from 2015

3.2 Temperature (daily-average) spatial data

3.2.1 GCM Temperature data in historical period (1950-2014)

Temperature data obtained from the CMIP-6 model simulations during 1950 to 2014 shows that the yearly maximum of the daily-mean air temperature, K increased significantly in the northern and central parts of the basin. The spatial trends in the temperature for various years in the study duration is shown in Figure 18. Historically the Vidarbha region in Maharashtra state has been experiencing the rise in yearly average temperatures.

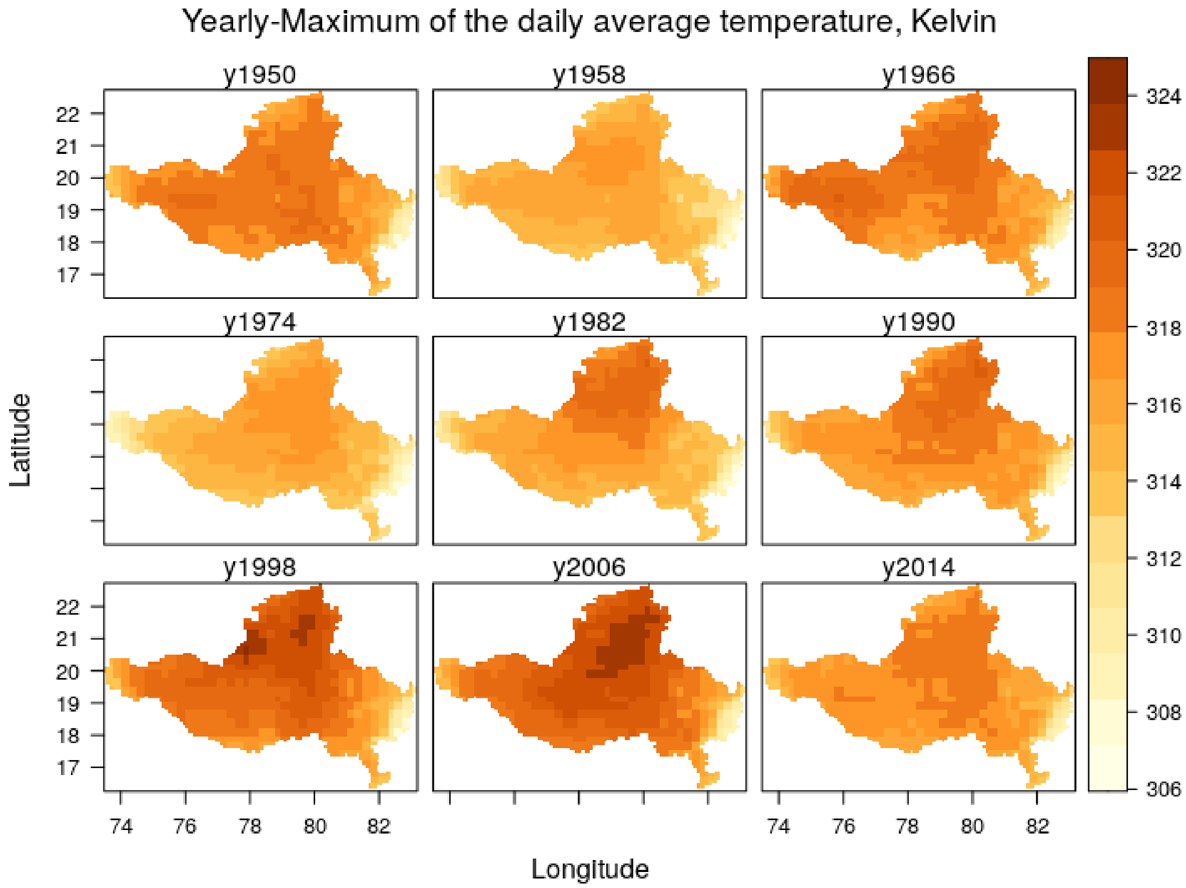

Figure 18 Yearly maximum of the daily-mean Temperature, K in the basin for several years during 1950-2014 (Source: NASA-GDDP-CMIP6). The values are simulation output of ACCESS-CM2 model

3.2.2 GCM Temperature data in near future (2015-2050)

The near future duration 2015-2050 is considered in the study for capturing the spatial trends in the air temperature data. Two future climate change scenarios viz. Shared Socioeconomic Pathways (SSPs)-245 and SSP-585 were considered. These two scenarios viz. SSP-245 and SSP-585 represent the benign and harsh climatic scenarios, respectively. The scenario-wise analyses of the data are presented in the following sub-sections.

3.2.2.1 SSP-245 Scenario

The yearly-maximum of daily average air temperature trends in the basin for 2015-2050 in SSP-245 are presented in Figure 19. Data shows that the air temperature trends are expected to be increased more north-central parts of the basin.

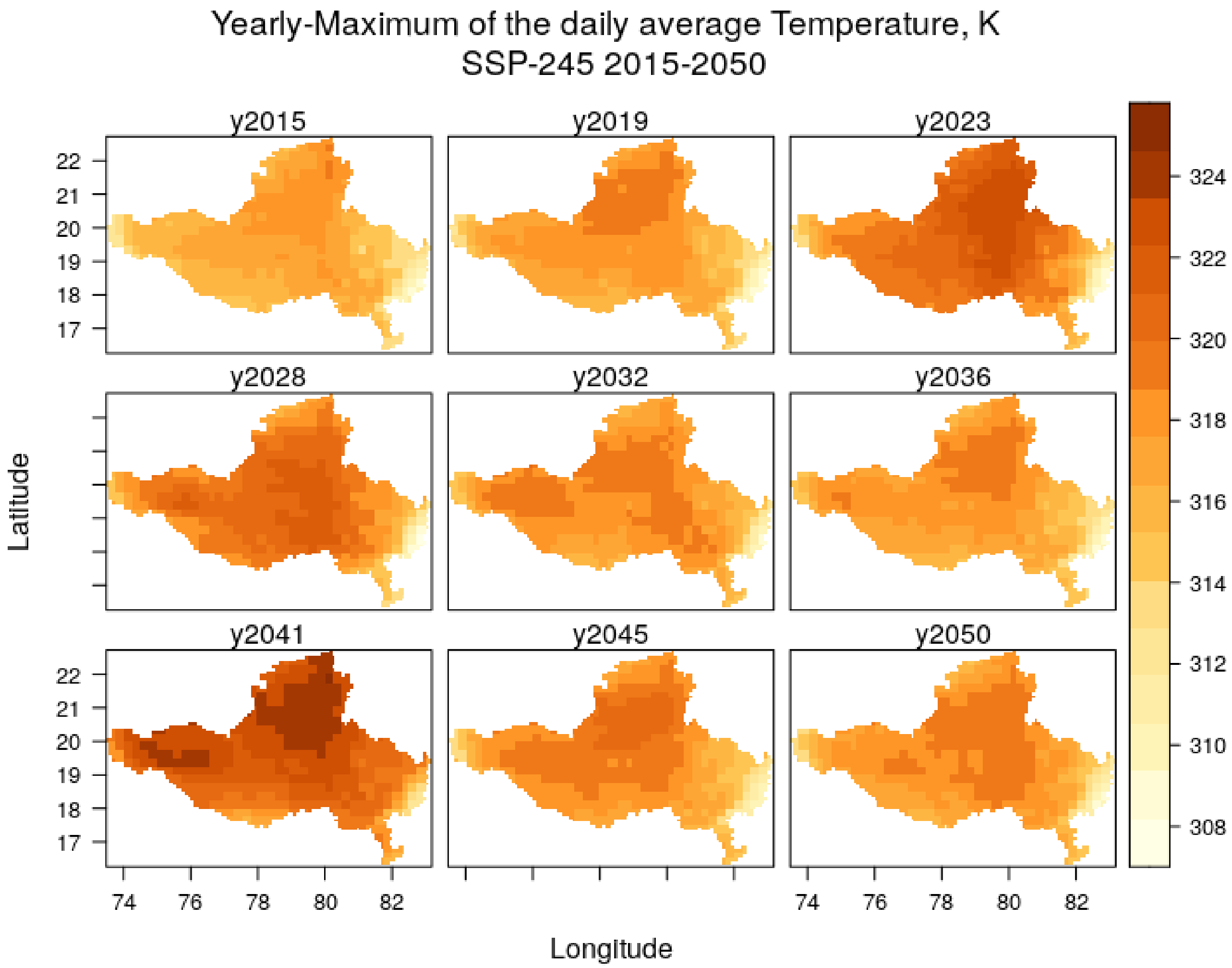

Figure 19 Yearly maximum of the daily-mean air temperature (K) in the basin for several years during 2015-2050 for the scenario SSP-245 (Source: NASA-GDDP-CMIP6). The values are simulation output of ACCESS-CM2 model

3.2.2.2 SSP-585 Scenario

The yearly-maximum of daily average air temperature trends in the basin for 2015-2050 in SSP-585 are presented in Figure 20. Data shows that the yearly-maximum daily average air temperatures are expected to be concentrated more north-eastern and central parts of the basin.

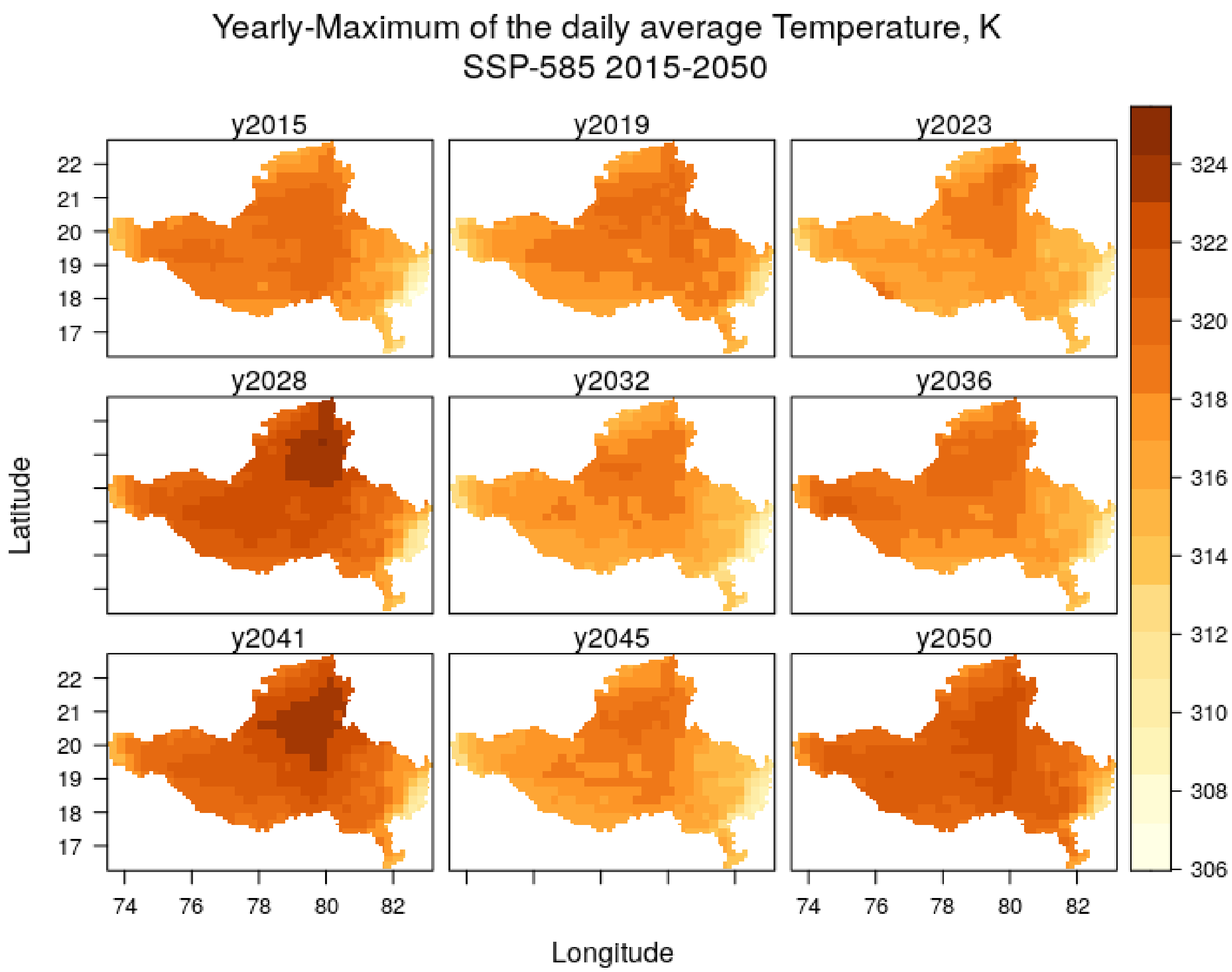

Figure 20 Yearly maximum of the daily-mean air temperature (K) in the basin for several years during 2015-2050 for the scenario SSP-585 (Source: NASA-GDDP-CMIP6). The values are simulation output of ACCESS-CM2 model

3.2.3 GCM Temperature data in far future (2051-2100)

Similar to the near-future analysis, the far-future trends in the spatial patterns of yearly maximum daily-averaged air temperature data during 2051 to 2100 was analysed in the basin. Two scenarios SSP-245 and SSP-585 were considered the analysis is presented in the following sub-sections.

3.2.3.1 SSP-245 Scenario

The air temperature trends in the basin for 2051-2100 in SSP-245 are presented in Figure 21. The data shows that the yearly-maximum daily-averaged air temperature values are expected to be increased more towards north and north-western.

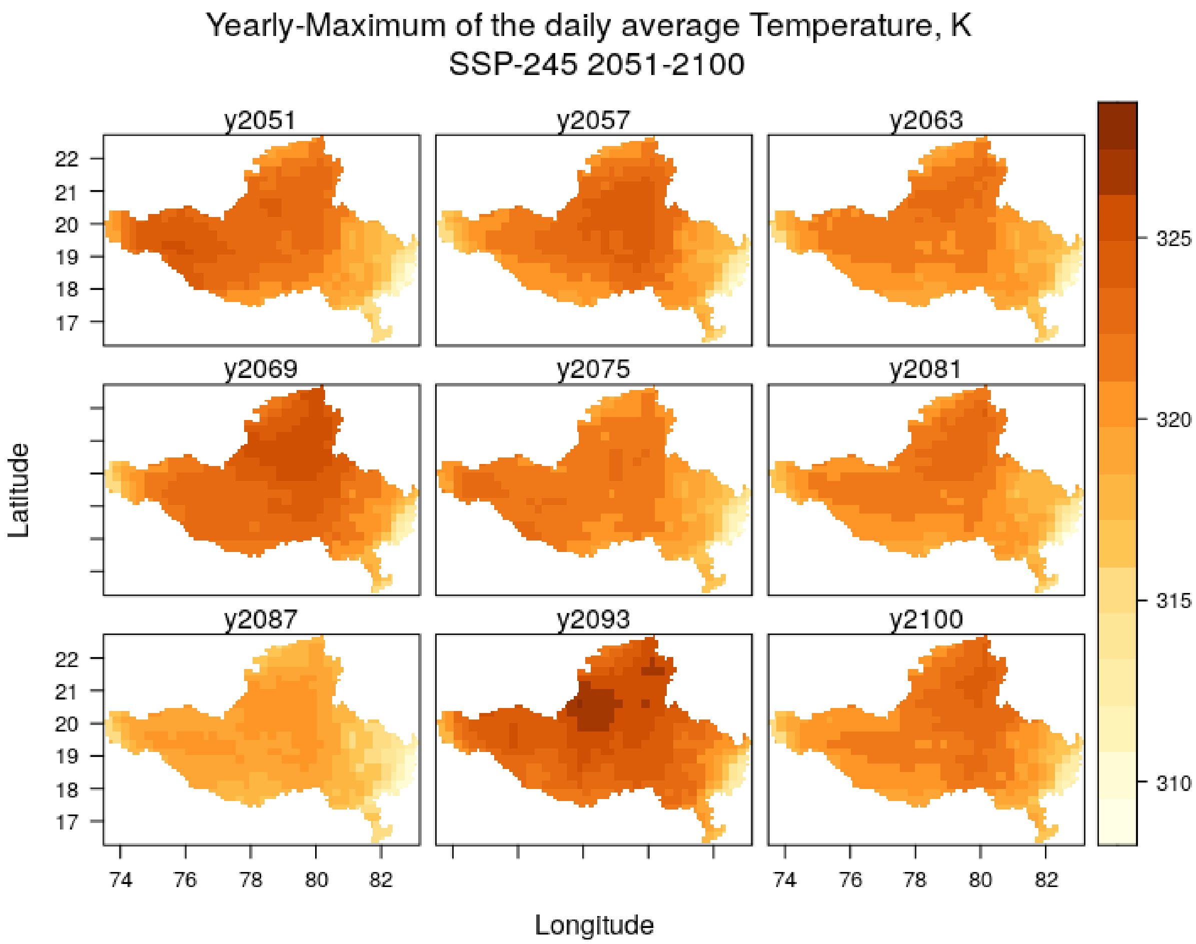

Figure 21 Yearly maximum of the daily-mean air temperature (K) in the basin for several years during 2051-2100 for the scenario SSP-245 (Source: NASA-GDDP-CMIP6). The values are simulation output of ACCESS-CM2 model

3.2.3.2 SSP-585 Scenario

The air temperature trends in the basin for 2051-2100 in SSP-585 are presented in Figure 22. The data shows that the yearly-maximum daily-averaged air temperature values are expected to be increased more central, north and north-western parts of the basin.

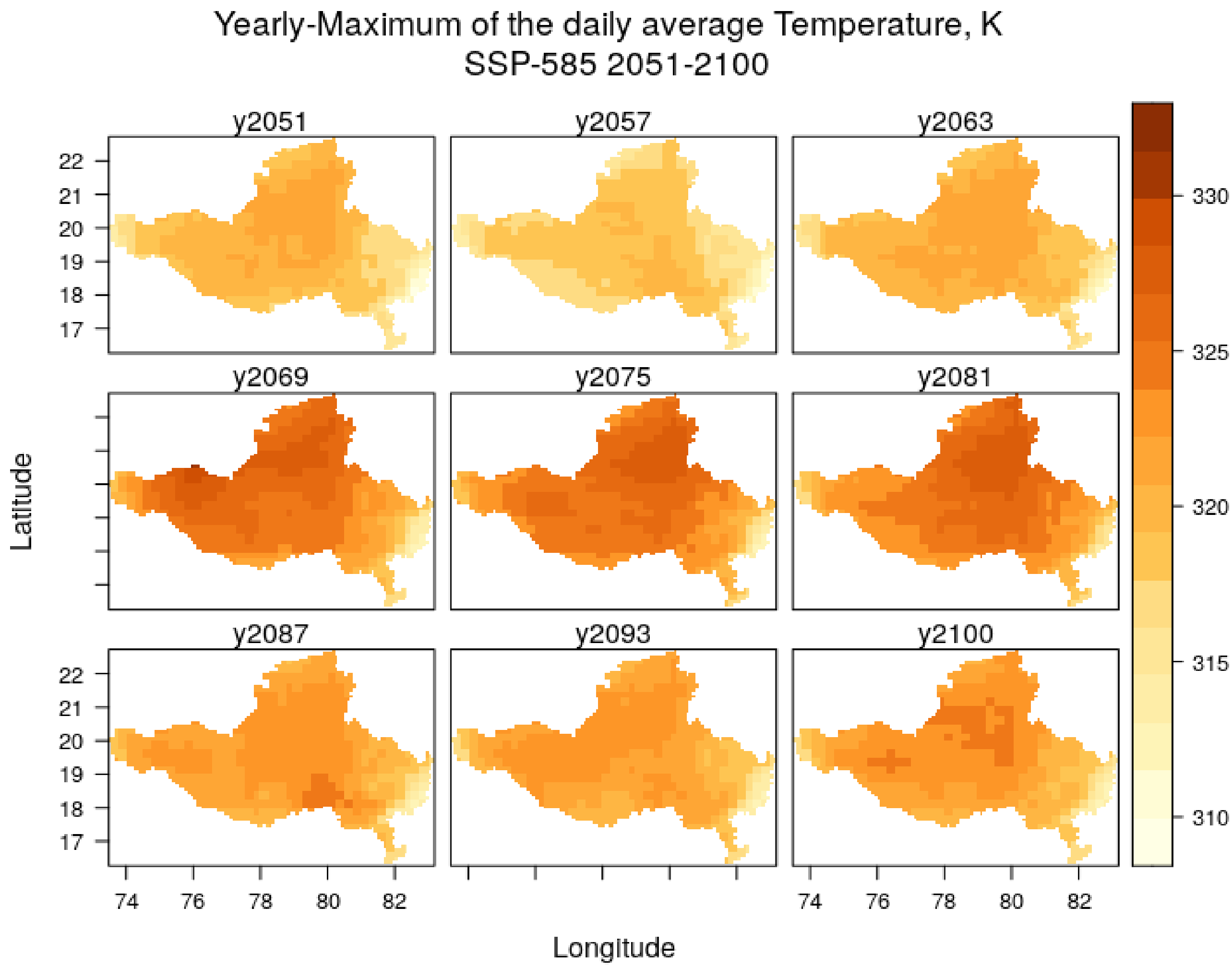

Figure 22 Yearly maximum of the daily-mean air temperature (K) in the basin for several years during 2051-2100 for the scenario SSP-585 (Source: NASA-GDDP-CMIP6). The values are simulation output of ACCESS-CM2 model

3.2.4 Time-series of Yearly-maximum Temperature

The time-series of the basin average (spatial-average) of the yearly-maximum daily-averaged air temperature is plotted in Figure 23. The data shows the historical trend in the air temperature data during 1950-2014, followed by the future simulated air temperature values for two scenarios SSP-245 and SSP-585. Analysis shows that the basin average yearly-maximum air temperature is expected to increase in the near and far-future in general, however, the rise is more in SSP-585 compared to that of SSP-245. Daily averaged air temperatures are set to increase in harsh climate change scenario compared to the benign one by 2 K. The increase in the air temperature values could severely impact the water balance in the basin and overall hydrology.

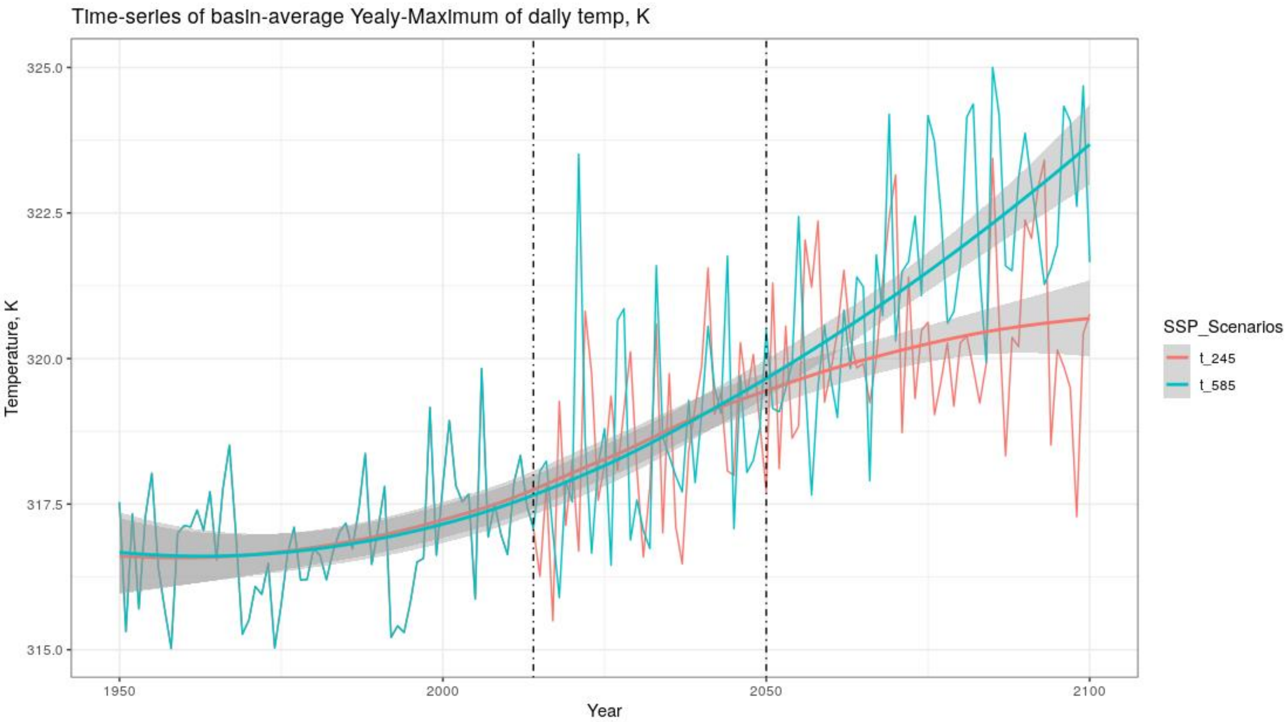

Figure 23 Time-series of basin-average of Yearly-maximum of daily temperature in Kelvins. The data ranges from 1950 to 2100 for future scenarios SSP-245 and SSP-585 from 2015

4 Drought data

Climate indices relating drought conditions such as Standard Precipitation Evapotranspiration Index (SPEI) was obtained in the river basin to understand the spatial trends in the drought. The SPEI data for the basin was obtained from CSIC-SPEI database (Spanish National Research Council) having 0.5-degree spatial resolution and monthly cadence. In the present study 6 monthly time scale data was used for the analysis. The SPEI is a standardized variate expresses the deviations of the current climatic balance (precipitation minus evapotranspiration potential) with respect to the long-term balance. For instance, the monthly SPEI values in 2022 is shown in Figure 24. Data shows that SPEI values are negative from March to June indicating the losses in moisture (high evapotranspiration and low precipitation), whereas high values are from August to December. The high SPEI values are in north-eastern parts of the basin, whereas low SPEI values are majorly towards south-western parts of the basins indicating potential drought areas.

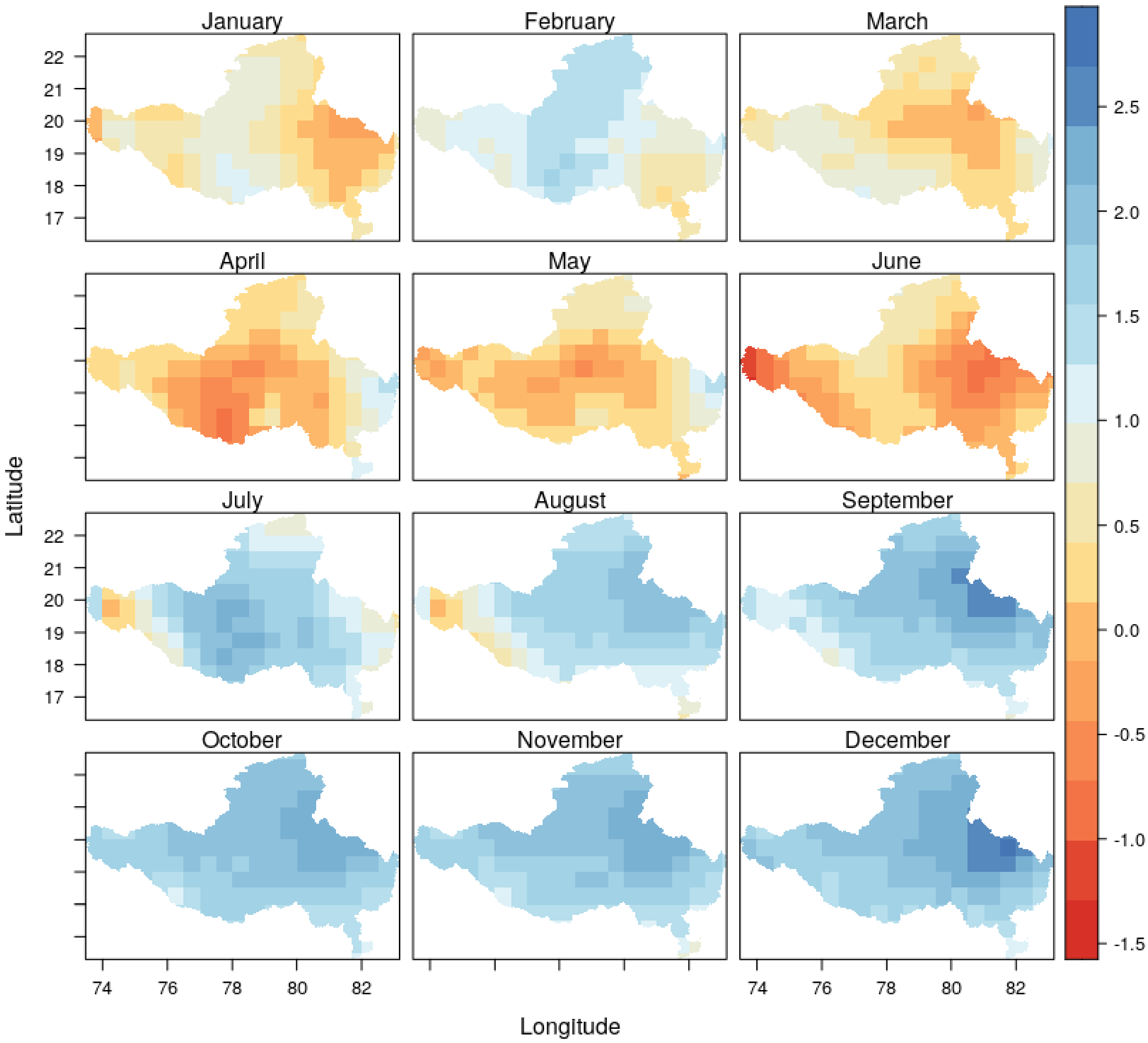

Figure 24 Monthly average SPEI values in Godavari Basin for 2022. Source: CSIC-SPEI

5 Summary

The objective of the present report is to populate the climatological and meteorological data available within Godavari basin. Meteorological data has been archived by CPCB web portals. At present there are around 12 cities from which the data has been retrieved. The seasonal trends in the daily average values of air temperature, relative humidity, precipitation, solar radiation, wind speed and direction from different cities were described in the report. Long-term climatic data include the spatial and temporal changes occurring in precipitation and temperature values in the basin. The historical and future datasets were obtained from a Global Climate Model, consisting data from 1950 to 2100. Future data has been divided into near-future (2015-2050) and far-future (2051-2100), for two different climate change scenarios viz. SSP-245 (benign scenario) and SSP-585 (harsh scenario). Results show considerable spatial variations occurring in the yearly-maximum precipitation and near surface temperatures. In overall, increasing trend in the basin-average of yearly-maximum precipitation and temperature have been observed in future time periods with considerable high in the scenario SSP-585 compare with that of SSP-245.

References

- CSIC-SEPI: https://spei.csic.es/database.html
- CPCB: Central Pollution Control Board. https://cpcb.nic.in/
- NASA-GDDP- CMIP-6: https://www.nccs.nasa.gov/services/data-collections/land-based-products/nex-gddp-cmip6