REGIONAL CLIMATE ASSESSMENT OF PRECIPITATION AND TEMPERATURE IN SOUTHERN PUNJAB (PAKISTAN) USING SIMCLIM CLIMATE MODEL FOR DIFFERENT TEMPORAL SCALES

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INTRODUCTION

Human activities have led to a significant increase in

- greenhouse gas concentrations, resulting in abnormal climate patterns globally and regionally.

Global circulation models (GCMs) forecast an escalation in the frequency and severity of these anomalies

Changes in climate patterns have led to

- Increased risks of extreme events such as floods, emphasizing the need for proactive adaptation strategies.

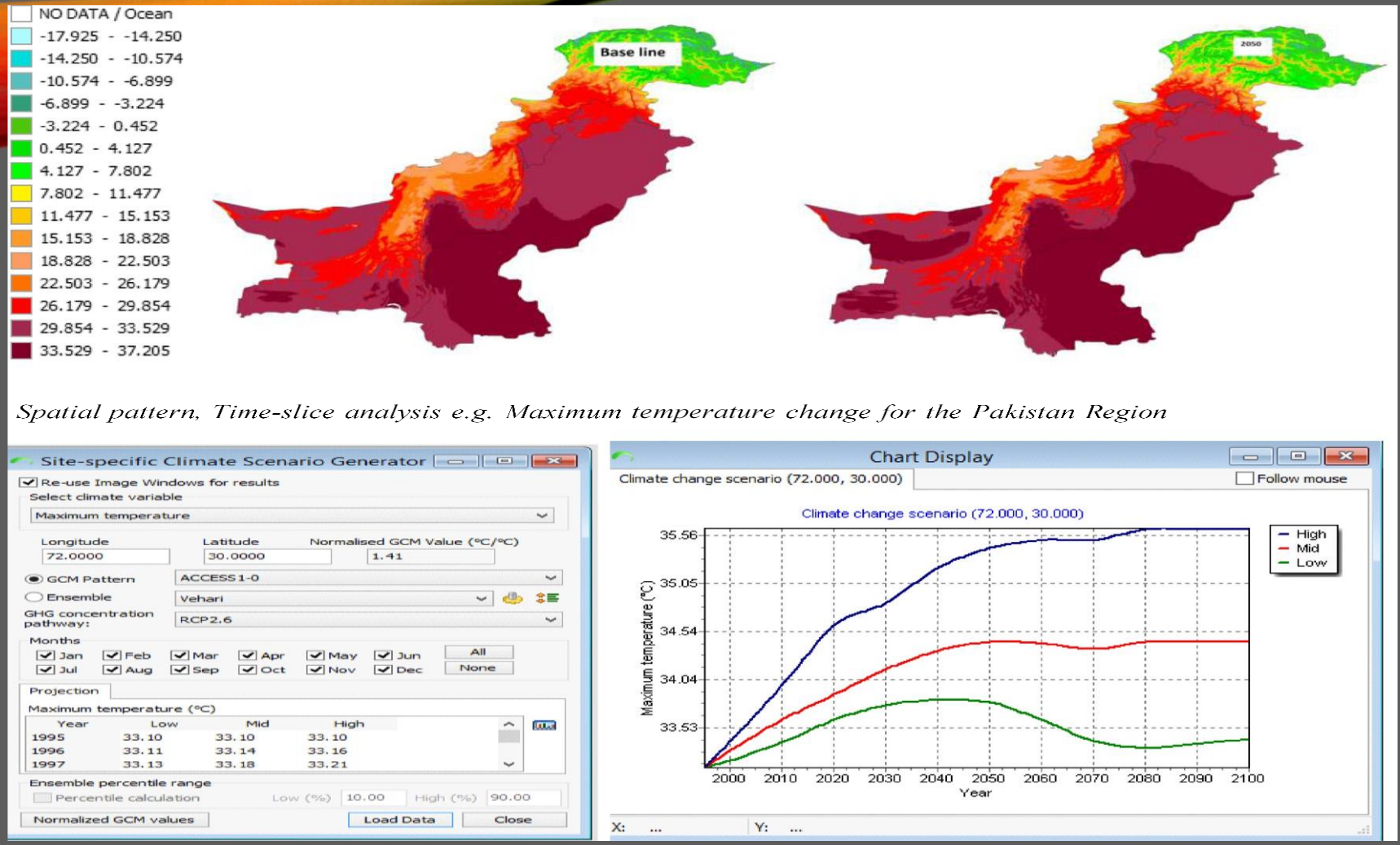
- Spatial scale in climate impact assessments can significantly influence the magnitude and direction of potential changes and associated impacts.

STUDY AREA AND DATA USED IN RESEARCH

- The study area Southern Punjab, Pakistan, with a focus on regions.
- Climatic data spanning 32 years (1980–2011) was utilized for baseline analysis, employing SimCLIM baseline projections.
- The study involved the examination of monthly temperature extremes (maximum and minimum) throughout the year, along with the monthly averages of precipitation.
- Graphical representations were utilized to visualize and analyze these climatic variables, aiding in understanding current climatic trends in the region.

IMPORTANT TOOLS AND FEATURES OF THE SIMCLIM SYSTEM

- SimCLIM is an open-framework modeling software designed for studying the impacts of climate change and extreme climatic events.
- It originated from CLIMPACTS in **New Zealand** and has been adapted for various countries and regions worldwide.
- SimCLIM is a customized GIS that allows users to analyze spatiotemporal variability in climatic conditions and their impacts on socio-economic sectors as .
- The system employs a top-down approach to incorporate global, regional, and local models, facilitating the study of impacts on human health, agriculture, and natural resource management at a specific region.



Spatial pattern, Time-slice analysis e.g. Maximum temperature change for the Pakistan Region

Time-series projections for Southern Punjab, Pakistan

Fig. 1 Spatial and site timeseries projections produced by SimCLIM scenario generator

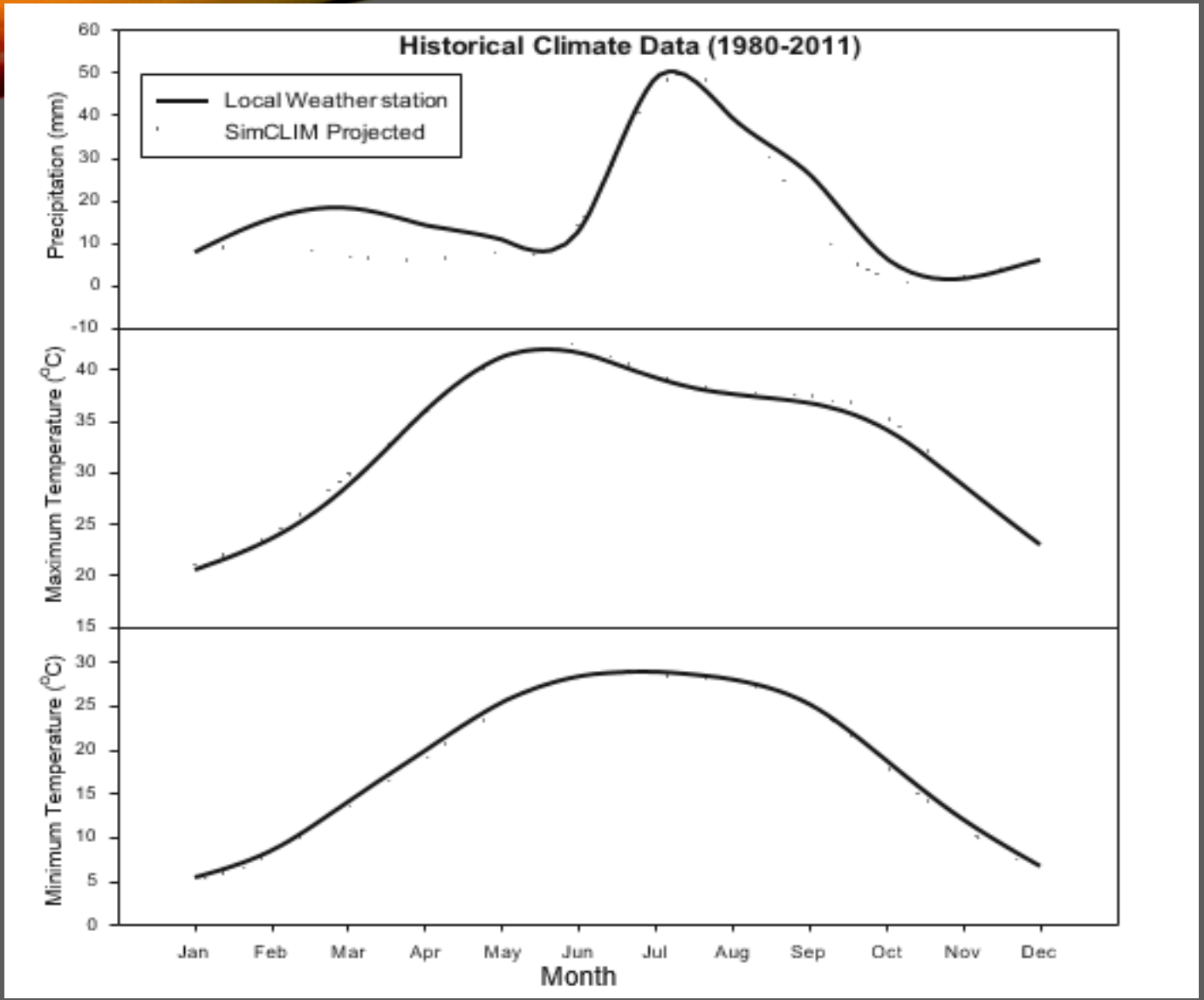


Fig. 2 Timescale evaluation for historical climatic data (1980– 2011) between local weather station (Multan) data and SimCLIM projected data (using 40 GCM ensemble) for Southern Pujnab, Pakistan

SELECTION OF CLIMATE MODELS AND FUTURE CLIMATE PROJECTIONS

- Choosing appropriate Global Climate Models (GCMs) is crucial for projecting future climate conditions at local or regional scales.
- GCMs with varying levels of climate sensitivity, represented by different Representative Concentration Pathways (RCPs), are utilized to capture the range of possible future climate scenarios. RCP4.5, RCP6.0, and RCP8.5 are commonly used to represent low, mid, and high-climate sensitivity scenarios.
- Pattern scaling methods are employed to combine outputs from different GCMs into a model ensemble, reducing the influence of outliers and providing a more representative prediction of future climate conditions.

- In this study, 40 GCMs were selected from SimCLIM to generate localized climate projections for Southern Punjab, Pakistan, based on observed climatic data from 1980 to 2011.
- Median scenario projections suggest a slight increase in annual rainfall for the study area by 2025 to 2050, with wettest months experiencing modest increases and driest months showing minimal changes.
- Understanding future climate projections is essential for informed decision-making and adaptation planning to mitigate the potential impacts of climate change on various sectors such as agriculture, water resources, and infrastructure.

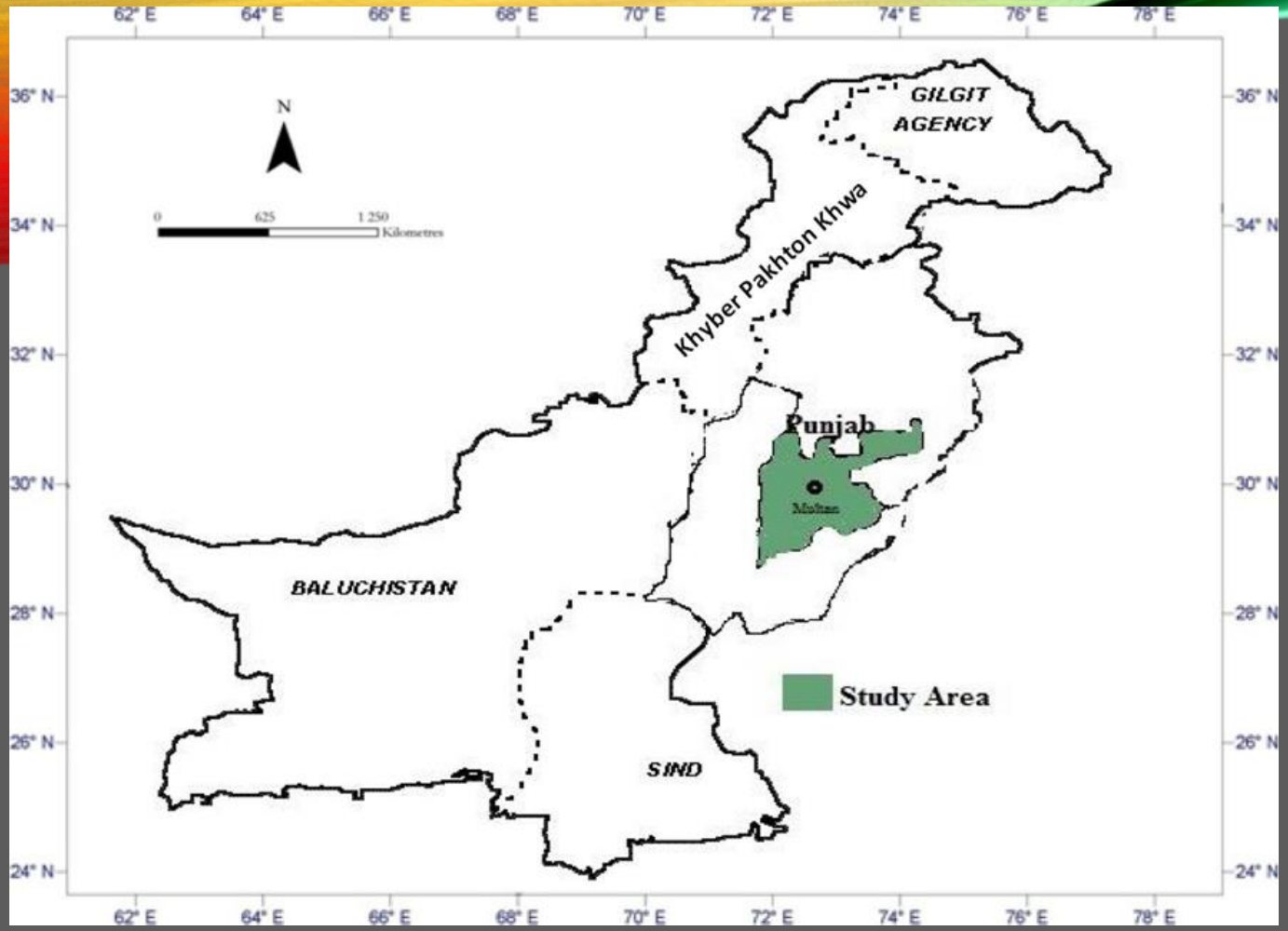


Fig. 3 Study area focuses on local weather station of Southern Punjab, Pakistan

Month	Rainfall (mm)		
	Baseline	2025	2050
Jan	7.59	7.24	6.98
Feb	15.53	15.18	14.92
Mar	17.99	17.26	16.71
Apr	13.89	13.45	13.12
May	10.52	11.02	11.4
Jun	12.62	13.55	14.24
Jul	48.6	51.4	53.49
Aug	39	40.62	41.83
Sep	25.96	28.75	30.84
Oct	6.1	6.96	7.6
Nov	1.35	1.51	1.64
Dec	5.77	5.84	5.89

Table 1 Mean Monthly rainfall of Southern Punjab for baseline, 2025 year and 2050 year using median scenario

RESULTS

Baseline parameters

- A 40-model ensemble (median) was used to predict climate change for 2025 and 2050 using SimCLIM.

PROJECTION OF PRECIPITATION FOR 2025 AND 2050

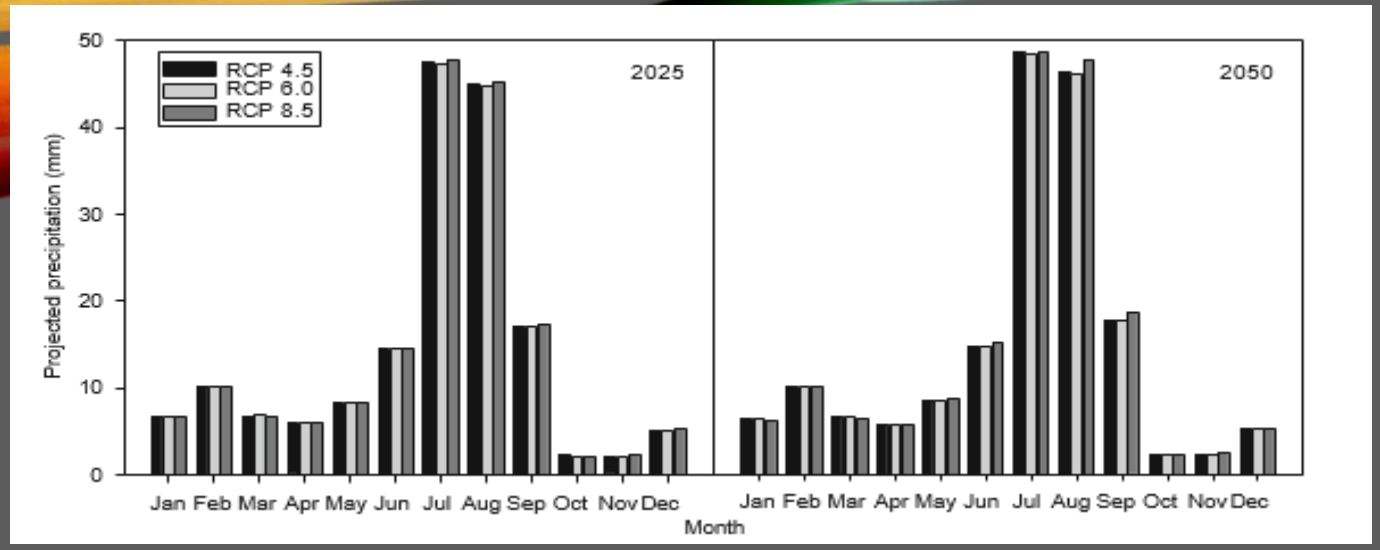


Fig. 4 Projected precipitation for 2025 and 2050 by using (ensemble) 40 GCMs with RCP-4.5, 6.0, and 8.5 for Southern Punjab, Pakistan

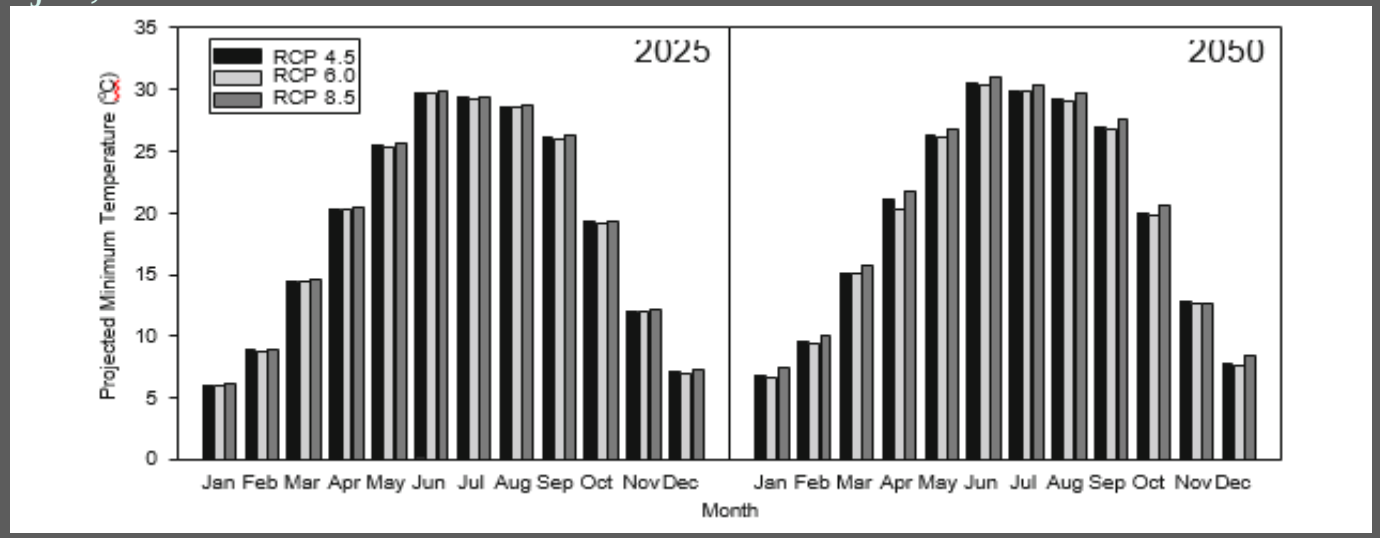


Fig. 5 Projected monthly averages of daily minimum temperature for 2025 and 2050 by using (ensemble) 40 GCMs with RCP-4.5, 6.0, and 8.5 for Southern Punjab, Pakistan

PROJECTION OF TEMPERATURE FOR 2025 AND 2050

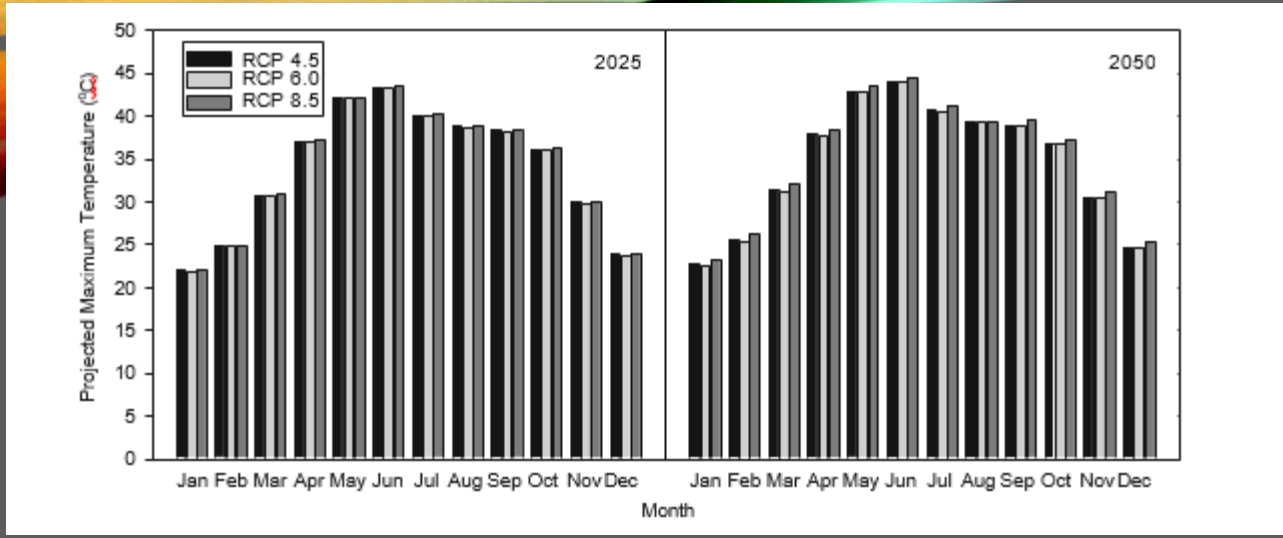


Fig. 6 Projected monthly averages of daily maximum temperature for 2025 and 2050 by using (ensemble) 40 GCMs with RCP-4.5, 6.0, and 8.5 for Southern Punjab, Pakistan

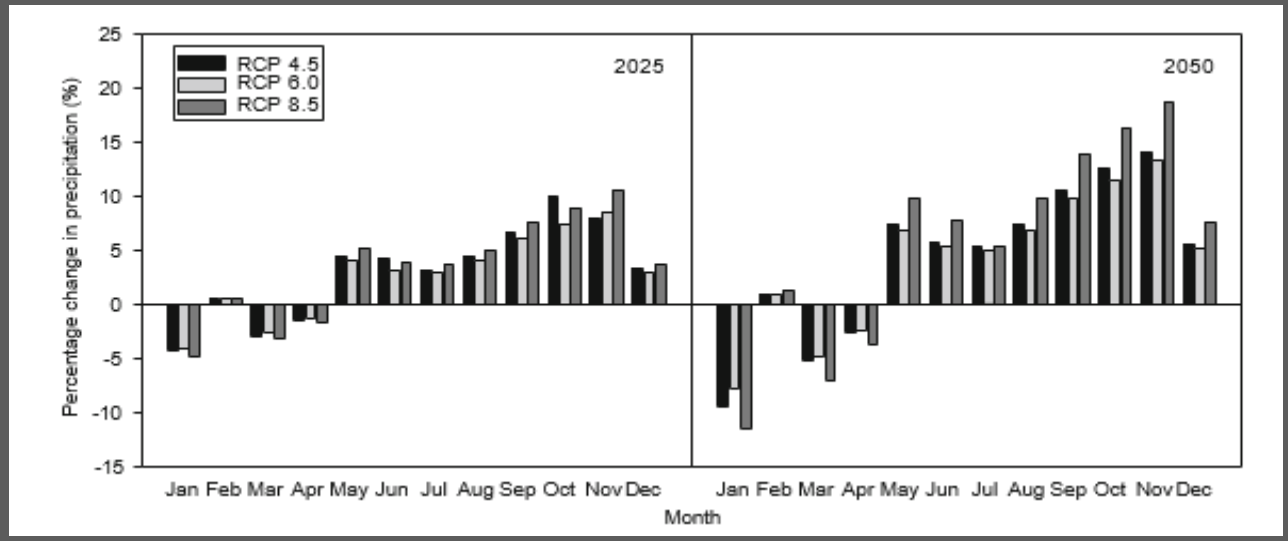


Fig. 7 Percentage change in precipitation from baseline (1980–2011) for 2025 and 2050 by using (ensemble) 40 GCMs with RCP-4.5, 6.0, and 8.5 for Southern Punjab, Pakistan

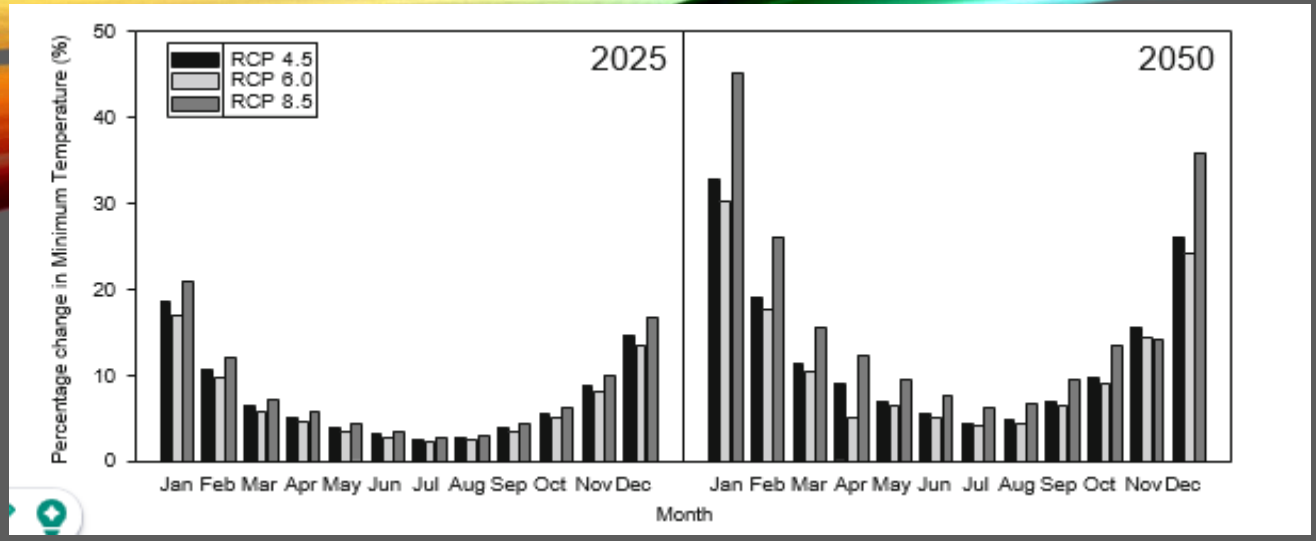


Fig. 8 Percentage change in monthly average minimum temperature from baseline (1980–2011) for 2025 and 2050 by using (ensemble) 40 GCMs with RCP-4.5, 6.0, and 8.5 for Southern Punjab, Pakistan

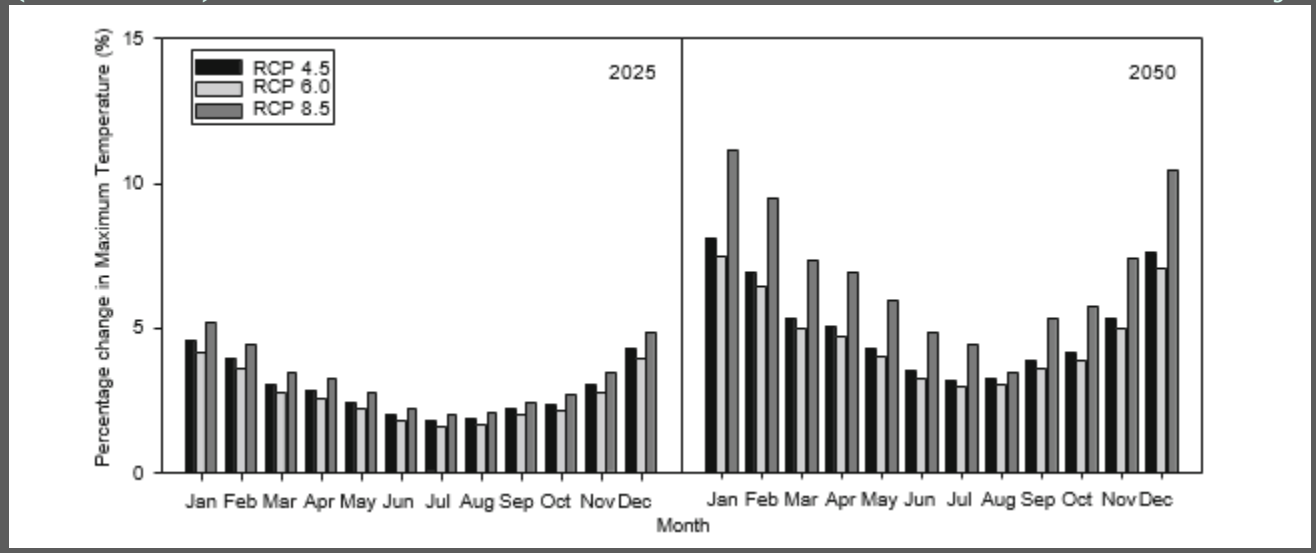


Fig. 9 Percentage change in monthly average maximum temperature from baseline (1980–2011) for 2025 and 2050 by using (ensemble) 40 GCMs with RCP-4.5, 6.0, and 8.5 for Southern Punjab, Pakistan

CONCLUSION

- The approach used in this study demonstrates an effective method for understanding model behavior under changing climates, offering several advantages for analyzing and presenting results from multi-model ensemble simulations.
- The percentage change in precipitation, minimum temperature, and maximum temperature projected by the models under different Representative Concentration Pathways (RCPs) for 2025 and 2050 reveal significant uncertainties.
- These uncertainties highlight the exposure of Southern Punjab, Pakistan, to major risks associated with climate change, including increases in maximum and minimum temperatures and large variations in precipitation in the near future.
- Future studies needed to further research on this important issue.
- We established CCSC/ICCFS & we are open for future collaboration, cooperation and joint-ventures with relevant organizations.

THANKS FOR PATIENCE

- For future research collaboration & cooperation

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