



Analysis of Projected Changes in Seasonal Precipitation Amounts for Central Asia

Using the CMIP6 Multi-Model Ensemble Approach

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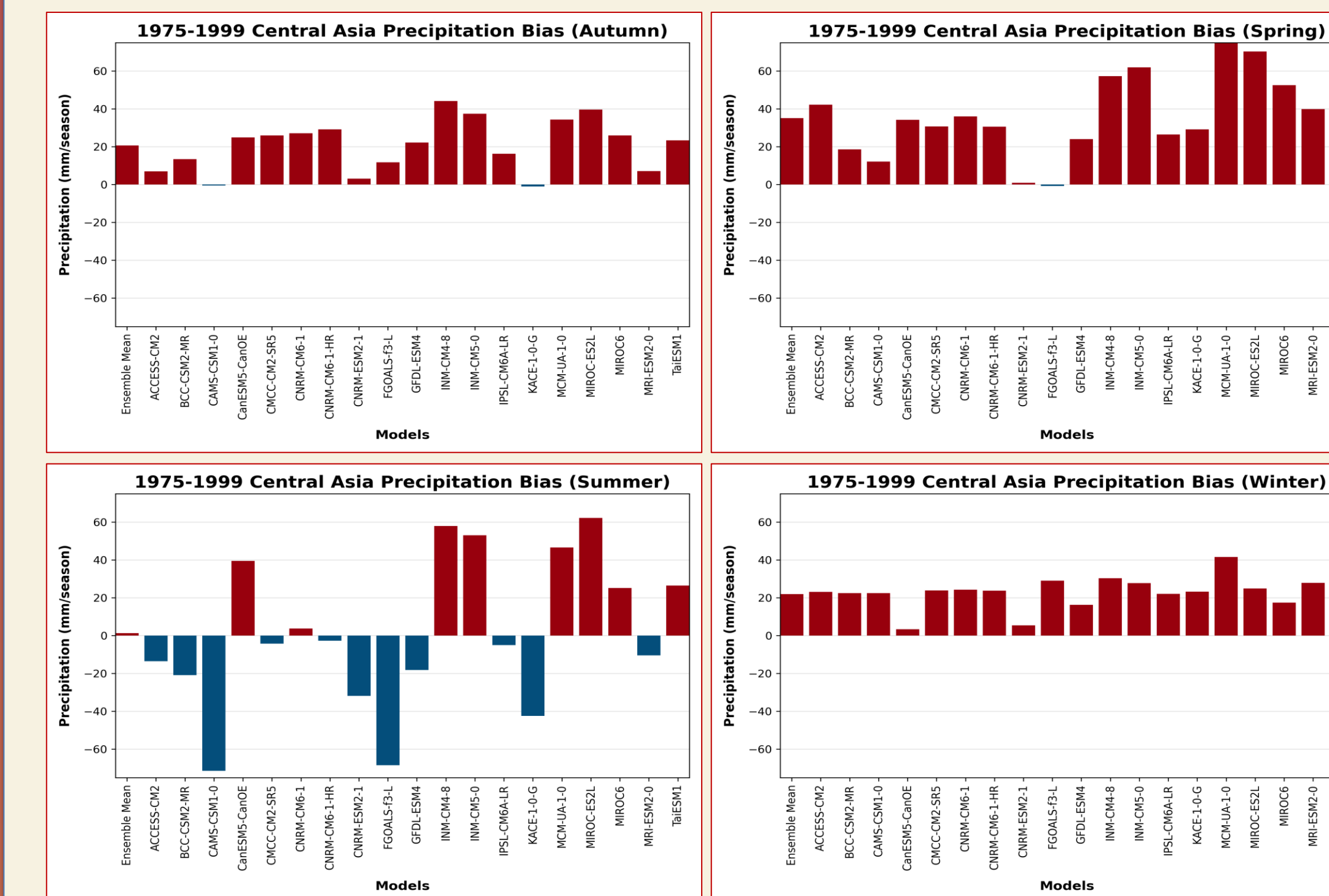


ABSTRACT

Particularly due to its arid and semi-arid nature, the environmental, ecological and socio-economic systems of Central Asia are under serious threat of climate change. Depending on the climate change in Central Asia, water resources spread over limited physiographic regions in the domain, grasslands and related livestock are the elements that will be adversely affected by the negative changes. The vital resource in the arid and semi-arid Central Asia region, which is a kind of large continental rain shadow basin surrounded by mountains, is therefore water. For this reason, in this study, the changes in the total precipitation for Central Asia, which is the core region of the Asia continent and one of the 14 main domains of the COordinated Regional climate Downscaling EXperiment (CORDEX), were examined within the scope of Coupled Model Intercomparison Project-Phase 6 (CMIP6) models. In the study, a multi-model ensemble mean approach was applied in order to investigate the projected changes in seasonal precipitation amounts for three different future quarters (i.e., 2025-2049, 2050-2074, and 2075-2099) with respect to the reference period of 1975-1999 under various Shared Socioeconomic Pathways (SSP2-4.5, SSP3-7.0).

FORCING DATA AND EXPERIMENT DESIGN	
Domain	Central Asia
Domain Coordinates	Lon: 11E-139E & Lat: 18N-56N
Global Climate Model	ACCESS-CM2, BCC-CSM2-MR, CAMS-CSM1-0, CanESM5-CanOE, CMCC-CM2-SR5, CNRM-CM6-1, CNRM-CM6-1-HR, CNRM-ESM2-1, FGOALS-f3-L, GFDL-ESM4, INM-CM4-8, INM-CM5-0, IPSL-CM6A-LR, KACE-1-0-G, MCM-UA-1-0, MIROC6, MIROC-ES2L, MRI-ESM2-0, TaiESM1
Variable	Precipitation
Grid Resolution	1° x 1°
Reference Time Scale	1975 - 1999
Future Time Scales	2025 – 2049, 2050 – 2074, 2075 – 2099,
Projection Scenarios	SSP2-4.5, SSP3-7.0

Table 1. Forcing Data and Experiment Design



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Figure 1. Seasonal bias of global climate models and ensemble mean according to CRU in total precipitation for the period of 1975-1999 and the Central Asia region.

CONCLUSION

This study investigates the potential impacts of climate change on total precipitation in Central Asia for three time periods - 2025-2049, 2050-2074, and 2075-2099 - under two different scenarios - SSP2-4.5 and SSP3-7.0 - in comparison to the baseline period of 1975-1999. Nineteen climate models were evaluated against CRU data, and an ensemble mean of all models was used to derive seasonal data on changes in total precipitation. The results indicate robust changes in total precipitation towards the end of the century for both scenarios, with the SSP3-7.0 scenario showing greater changes than the SSP2-4.5 scenario, but with similar spatial distribution. The study predicts an increase in total precipitation in southern and western China and India, while a decrease is projected for the Mediterranean region, eastern China, southern Japan, and the East China Sea. Furthermore, the seasonal analysis suggests more pronounced increments in winter and more substantial decrements in summer.

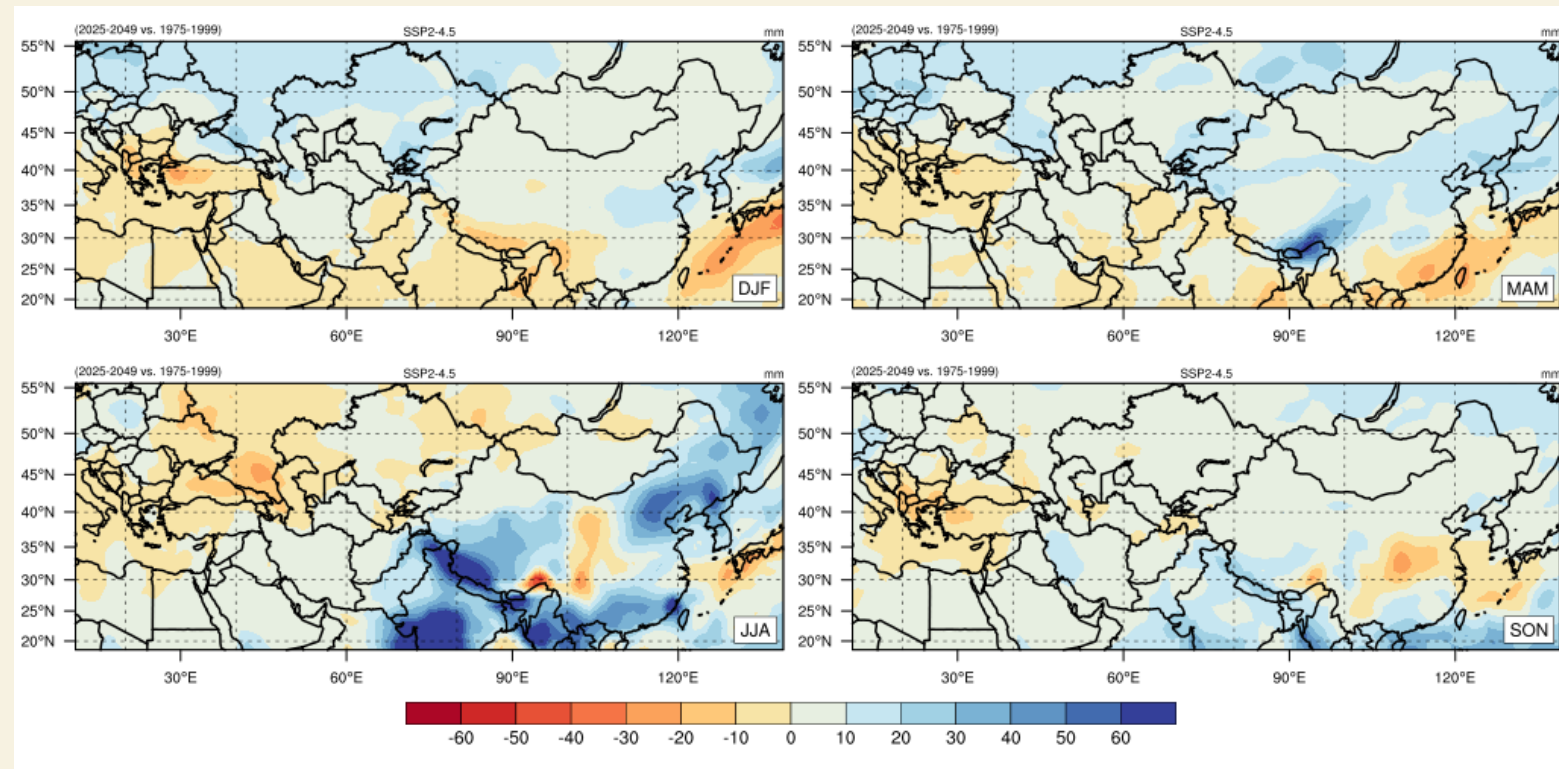


Figure 2. Projected change in total precipitation in the future period of 2025-2049 for Central Asia and SSP2-4.5 scenario compared to the 1975-1999 reference period.

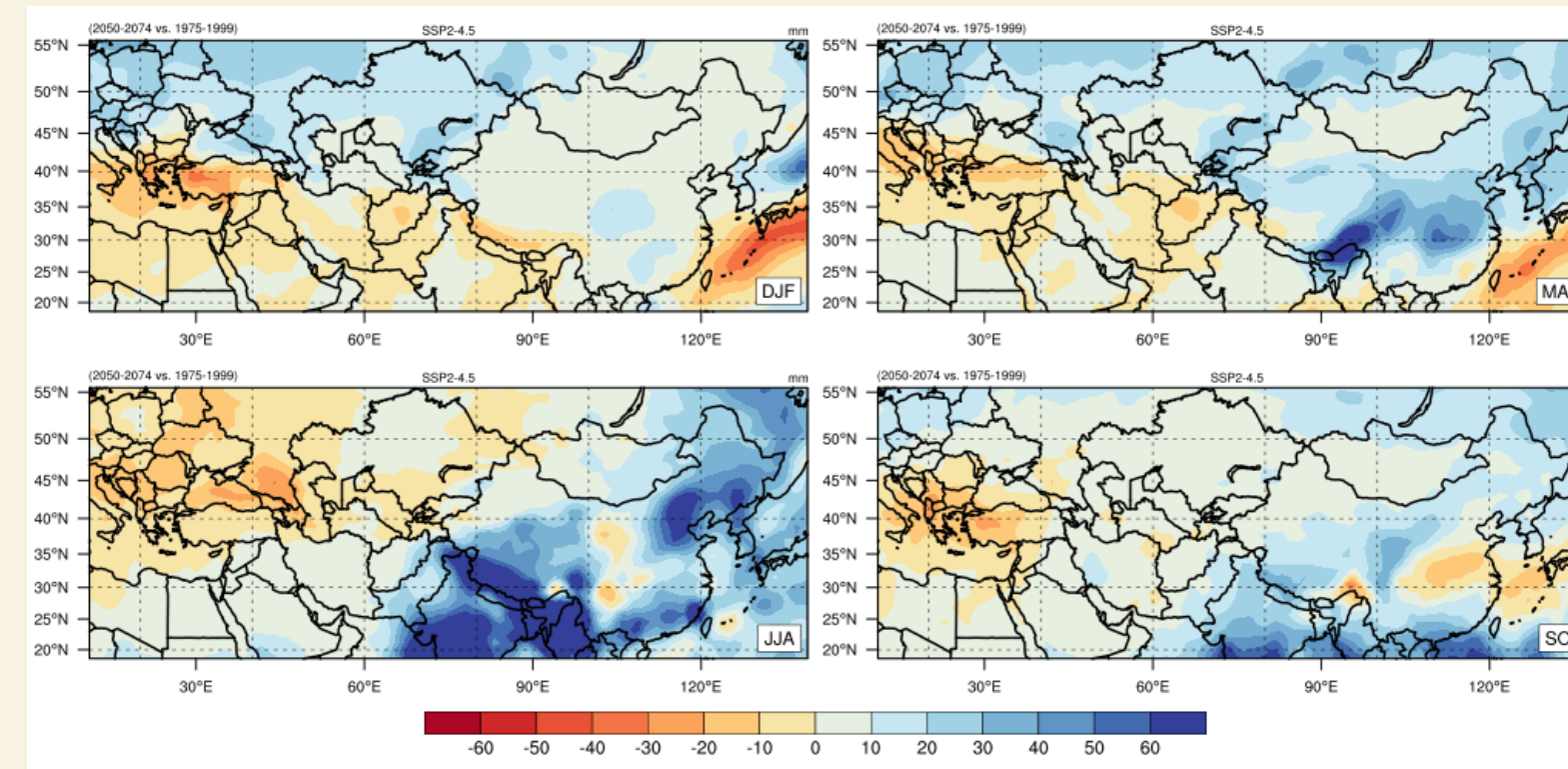


Figure 3. Projected change in total precipitation in the future period of 2050-2074 for Central Asia and SSP2-4.5 scenario compared to the 1975-1999 reference period.

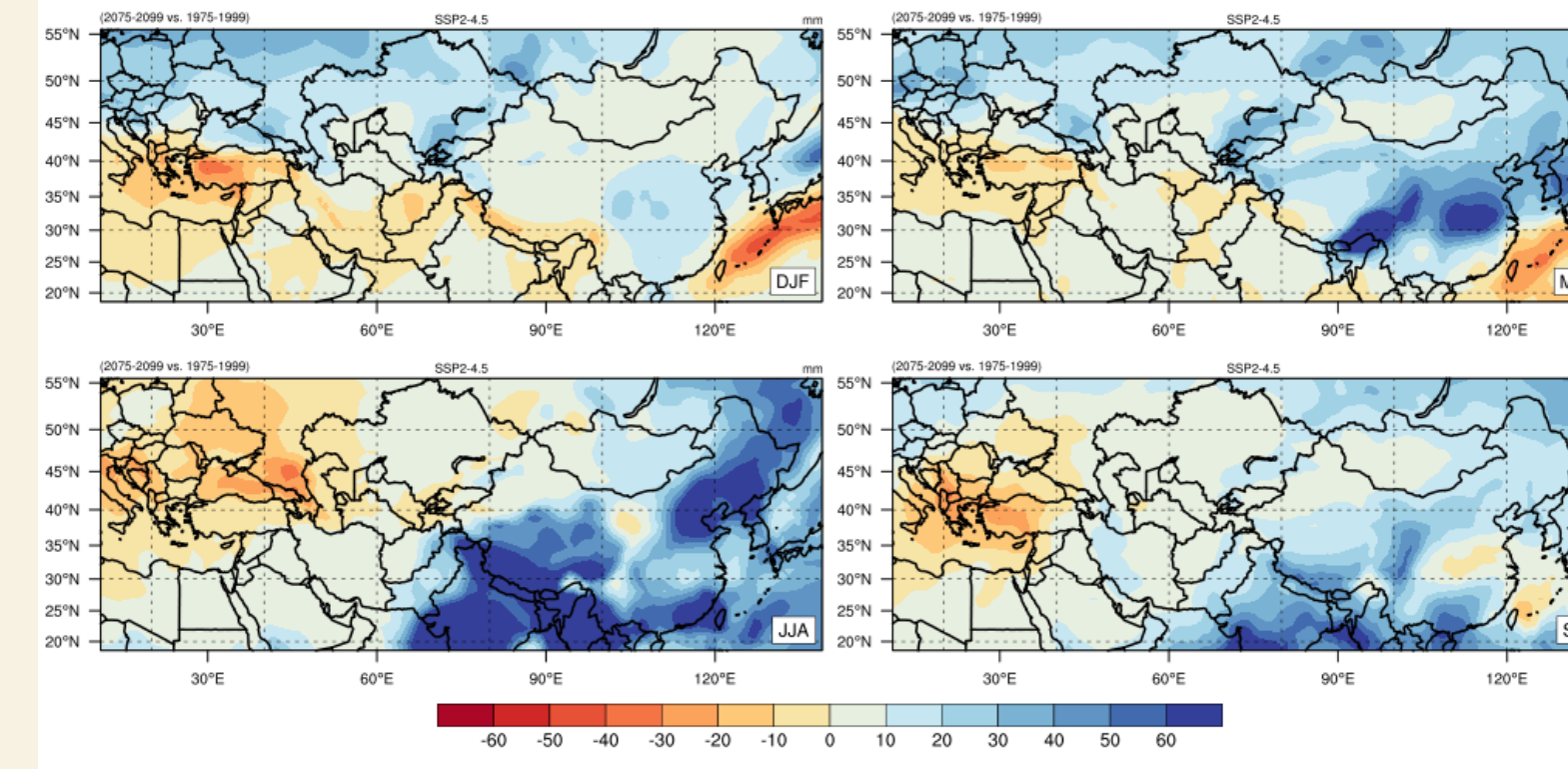


Figure 4. Projected change in total precipitation in the future period of 2075-2099 for Central Asia and SSP2-4.5 scenario compared to the 1975-1999 reference period.

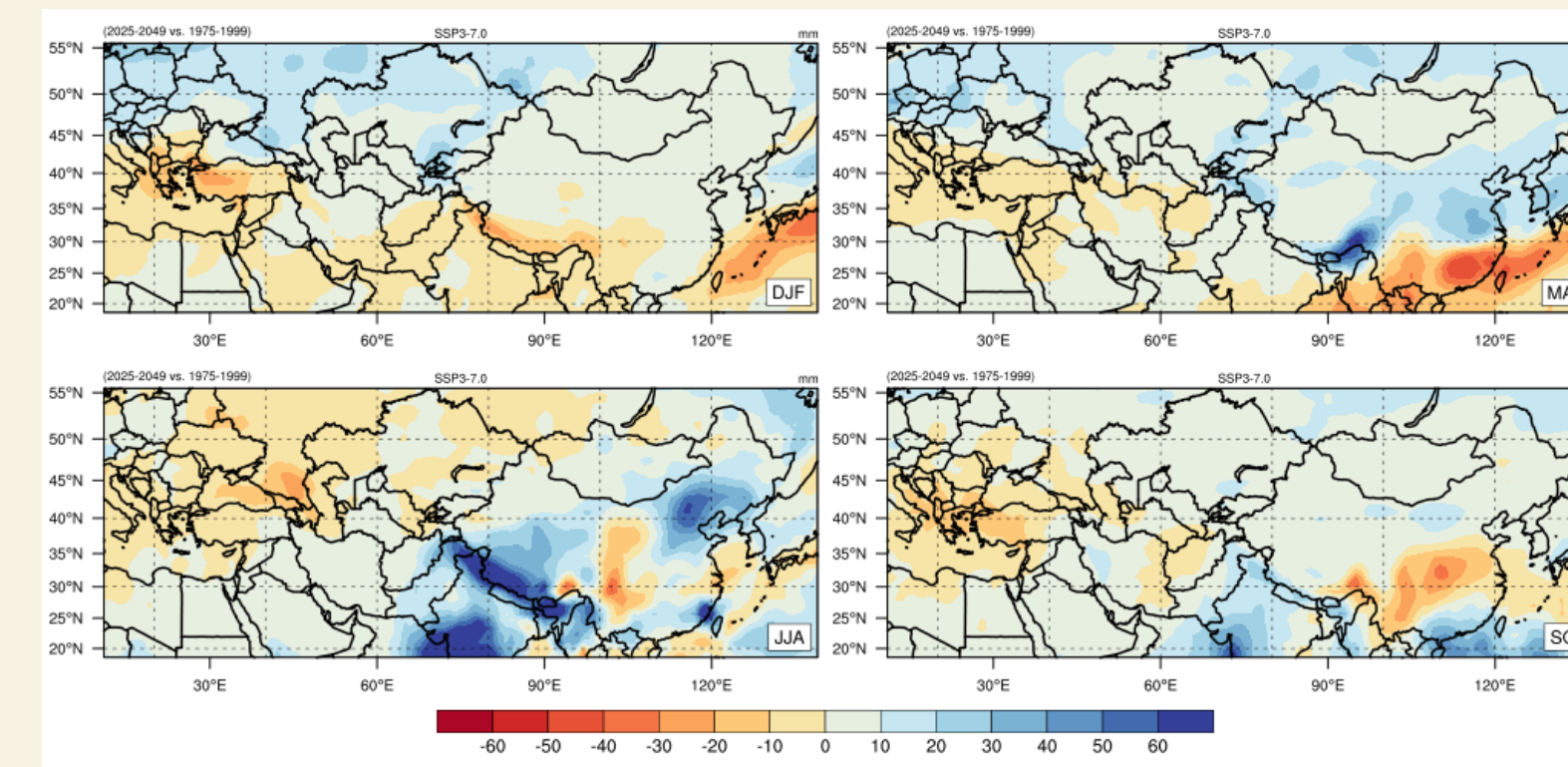


Figure 5. Projected change in total precipitation in the future period of 2025-2049 for Central Asia and SSP3-7.0 scenario compared to the 1975-1999 reference period.

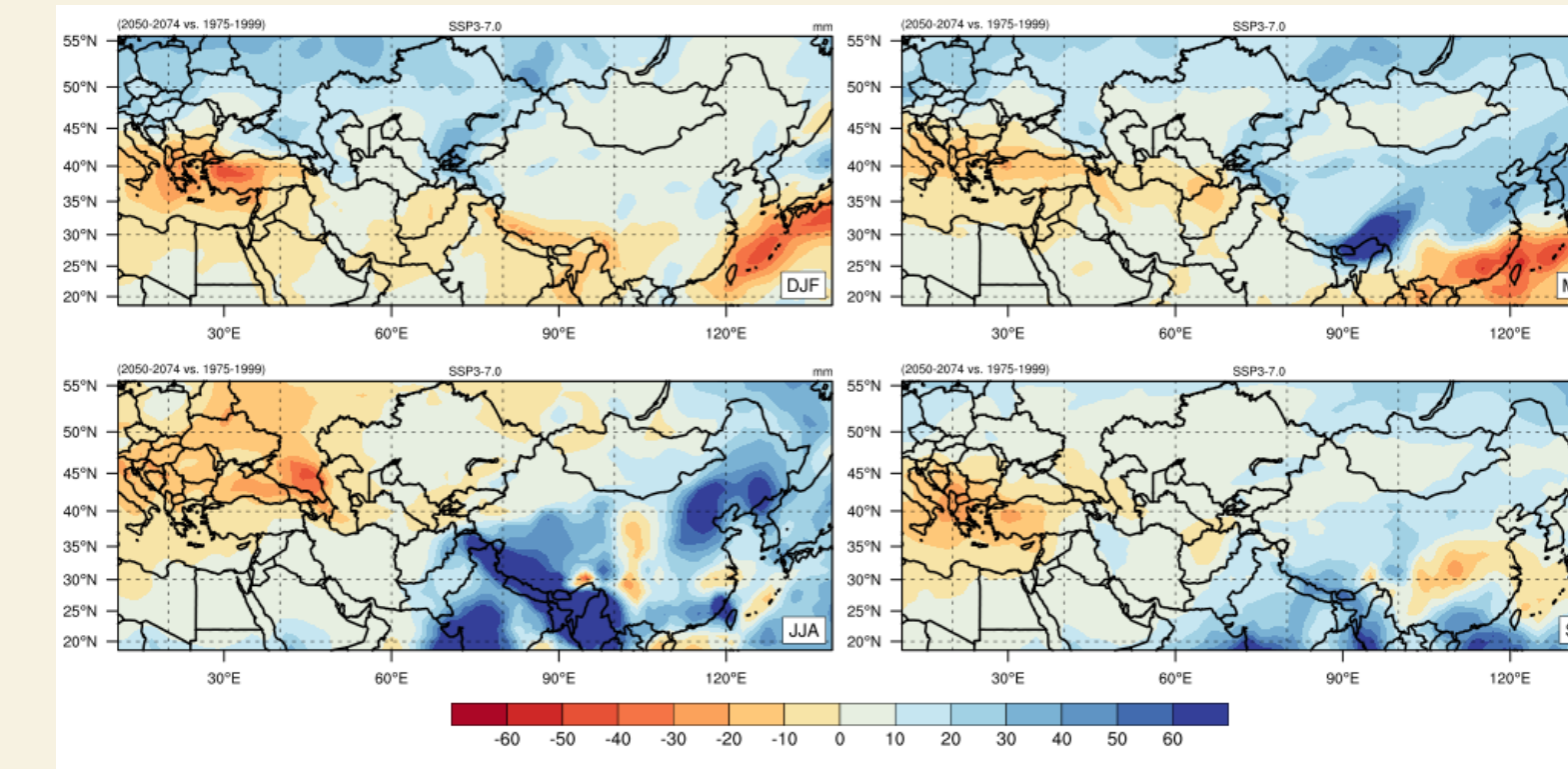


Figure 6. Projected change in total precipitation in the future period of 2050-2074 for Central Asia and SSP3-7.0 scenario compared to the 1975-1999 reference period.

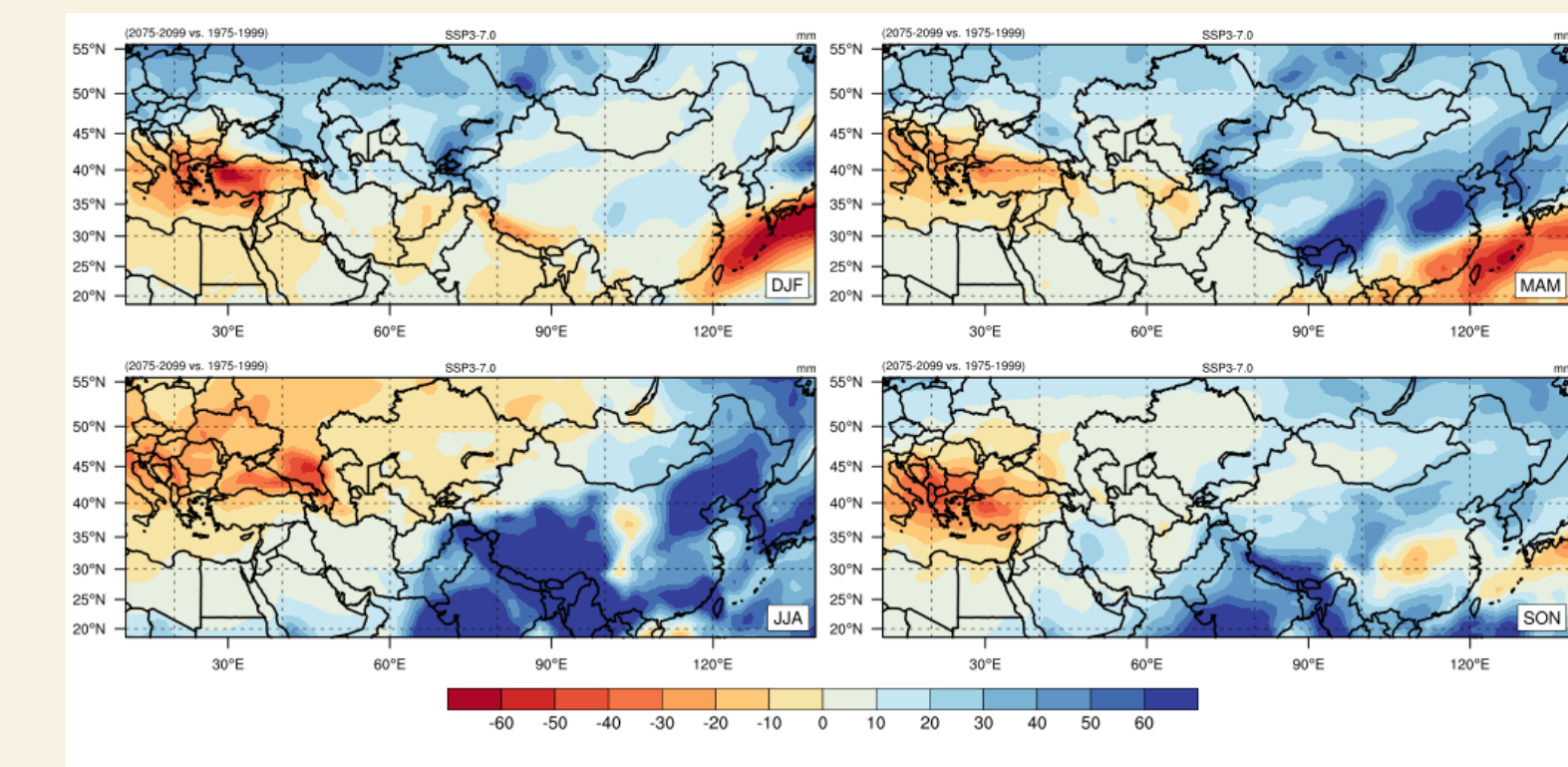


Figure 7. Projected change in total precipitation in the future period of 2075-2099 for Central Asia and SSP3-7.0 scenario compared to the 1975-1999 reference period.

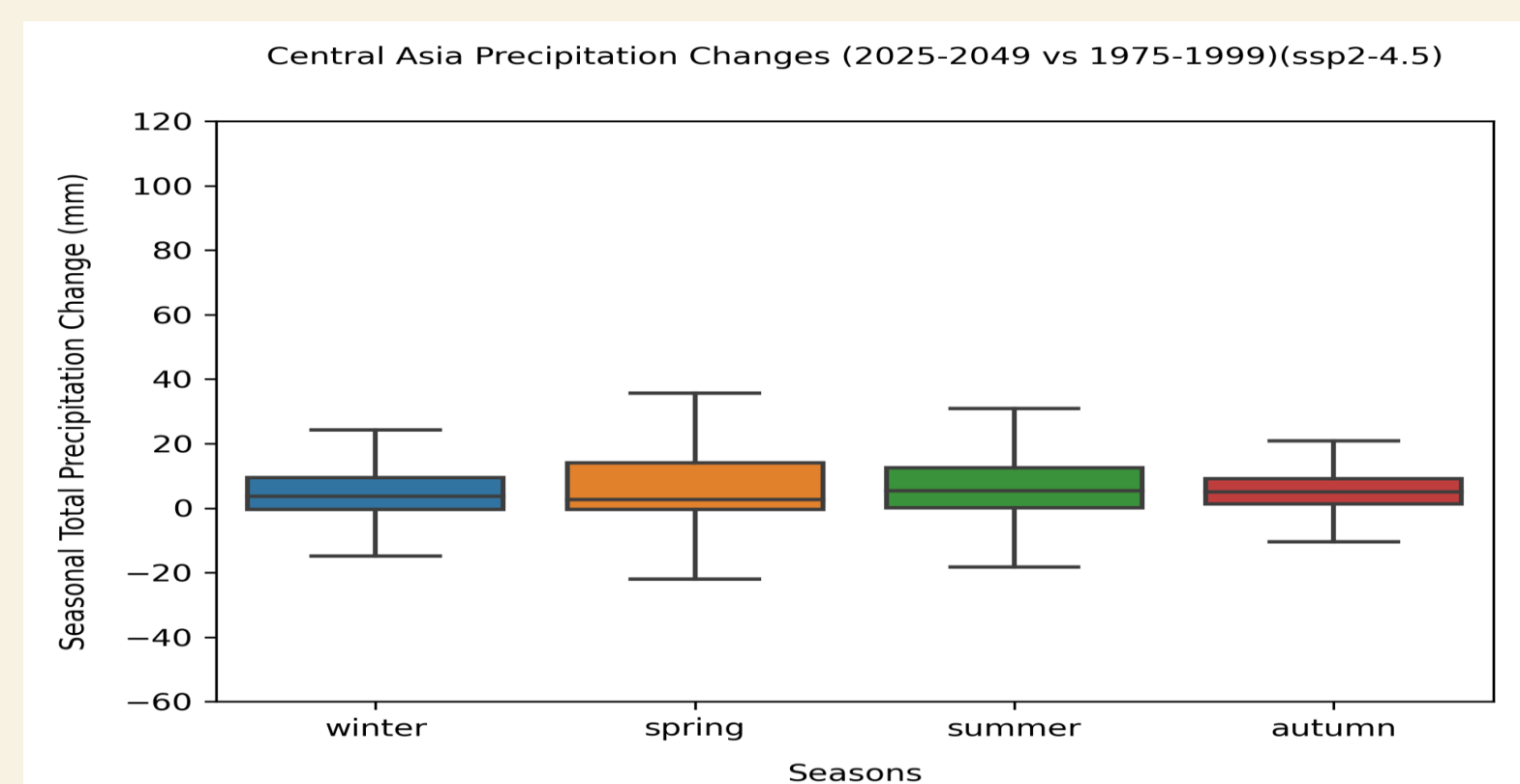


Figure 8. Projected change in total precipitation in the future period of 2025-2049 for Central Asia and SSP2-4.5 scenario compared to the 1975-1999 reference period.

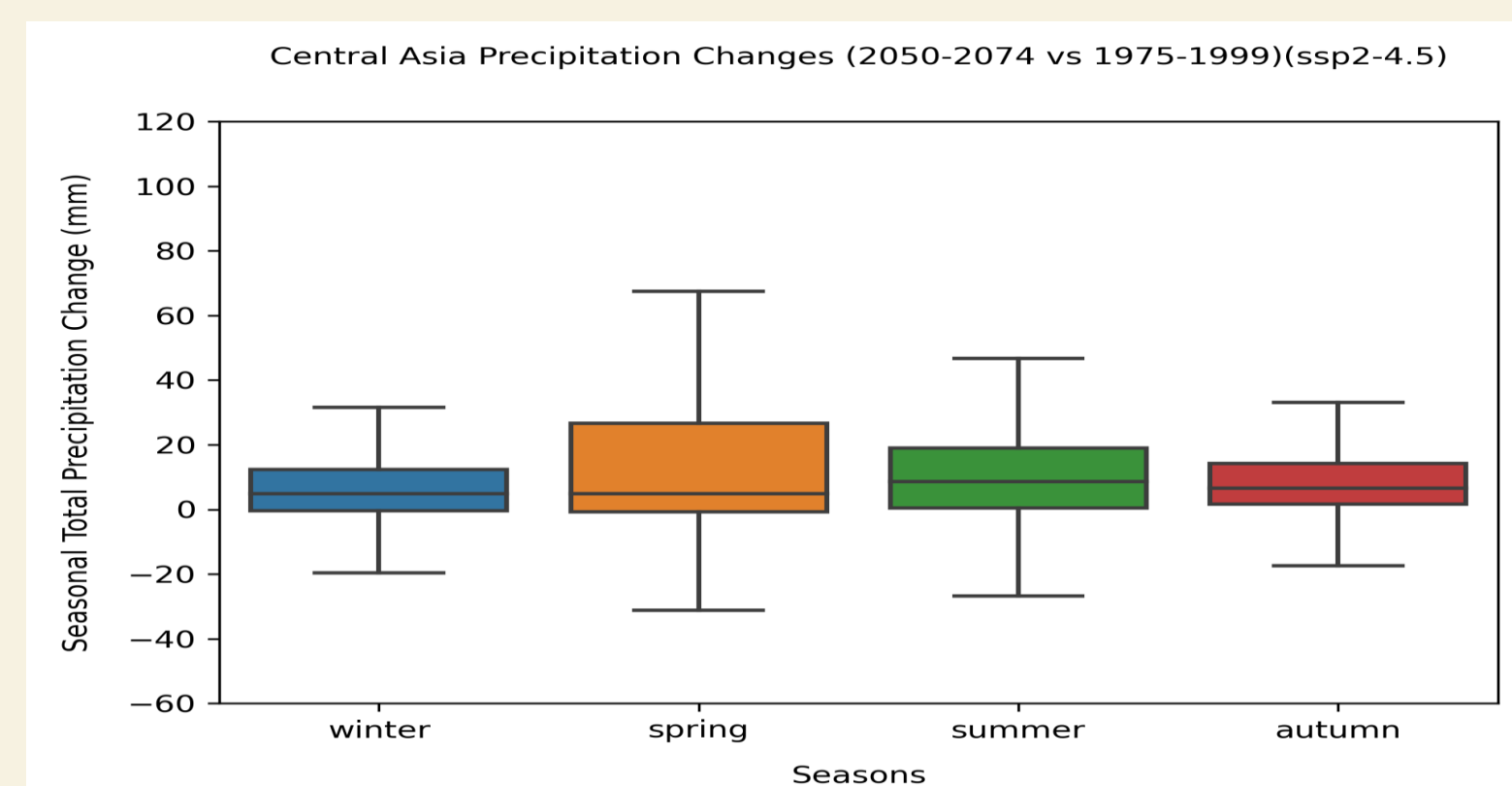


Figure 9. Projected change in total precipitation in the future period of 2050-2074 for Central Asia and SSP2-4.5 scenario compared to the 1975-1999 reference period.

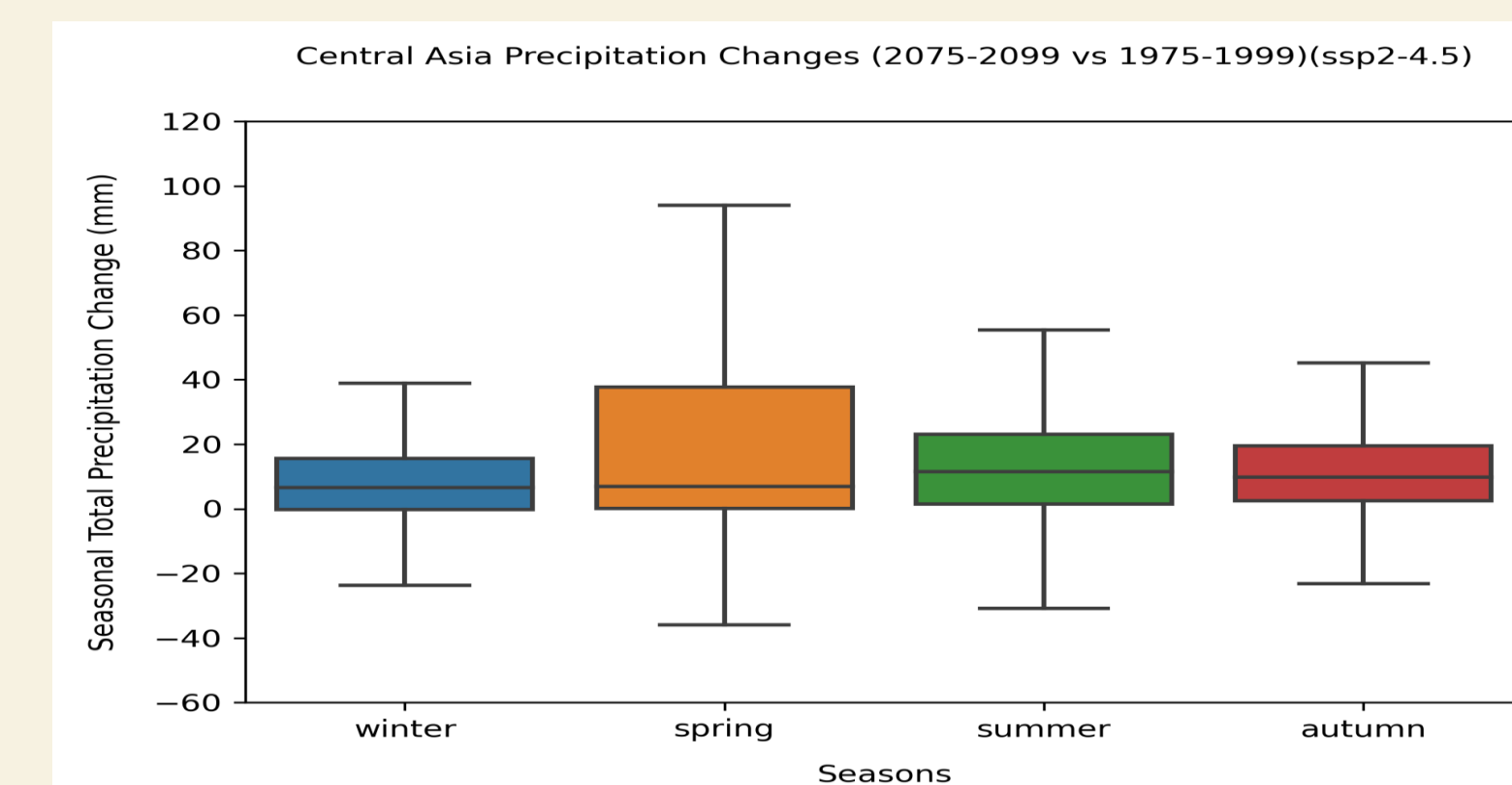


Figure 10. Projected change in total precipitation in the future period of 2075-2099 for Central Asia and SSP2-4.5 scenario compared to the 1975-1999 reference period.

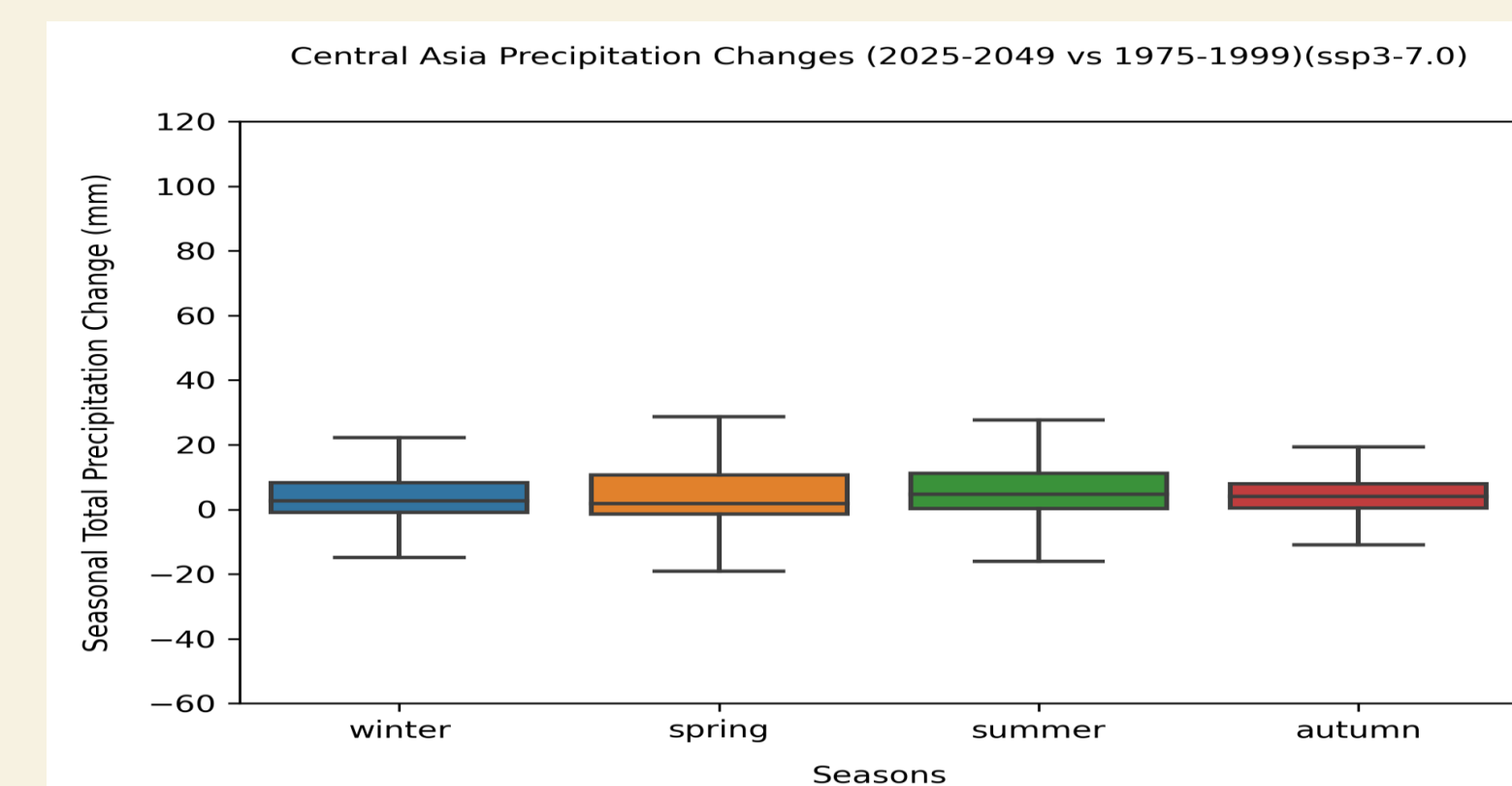


Figure 11. Projected change in total precipitation in the future period of 2025-2049 for Central Asia and SSP3-7.0 scenario compared to the 1975-1999 reference period.

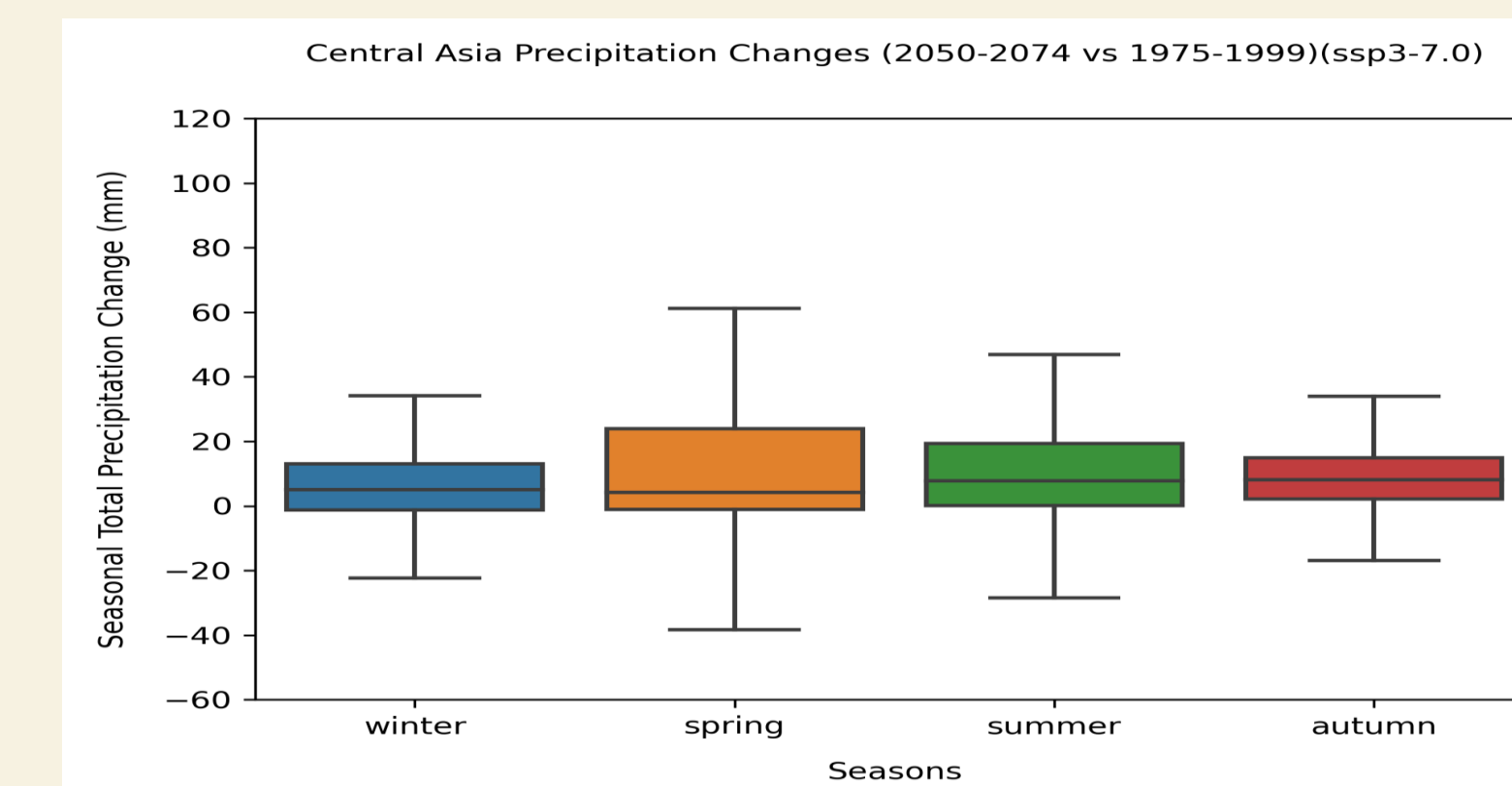


Figure 12. Projected change in total precipitation in the future period of 2050-2074 for Central Asia and SSP3-7.0 scenario compared to the 1975-1999 reference period.

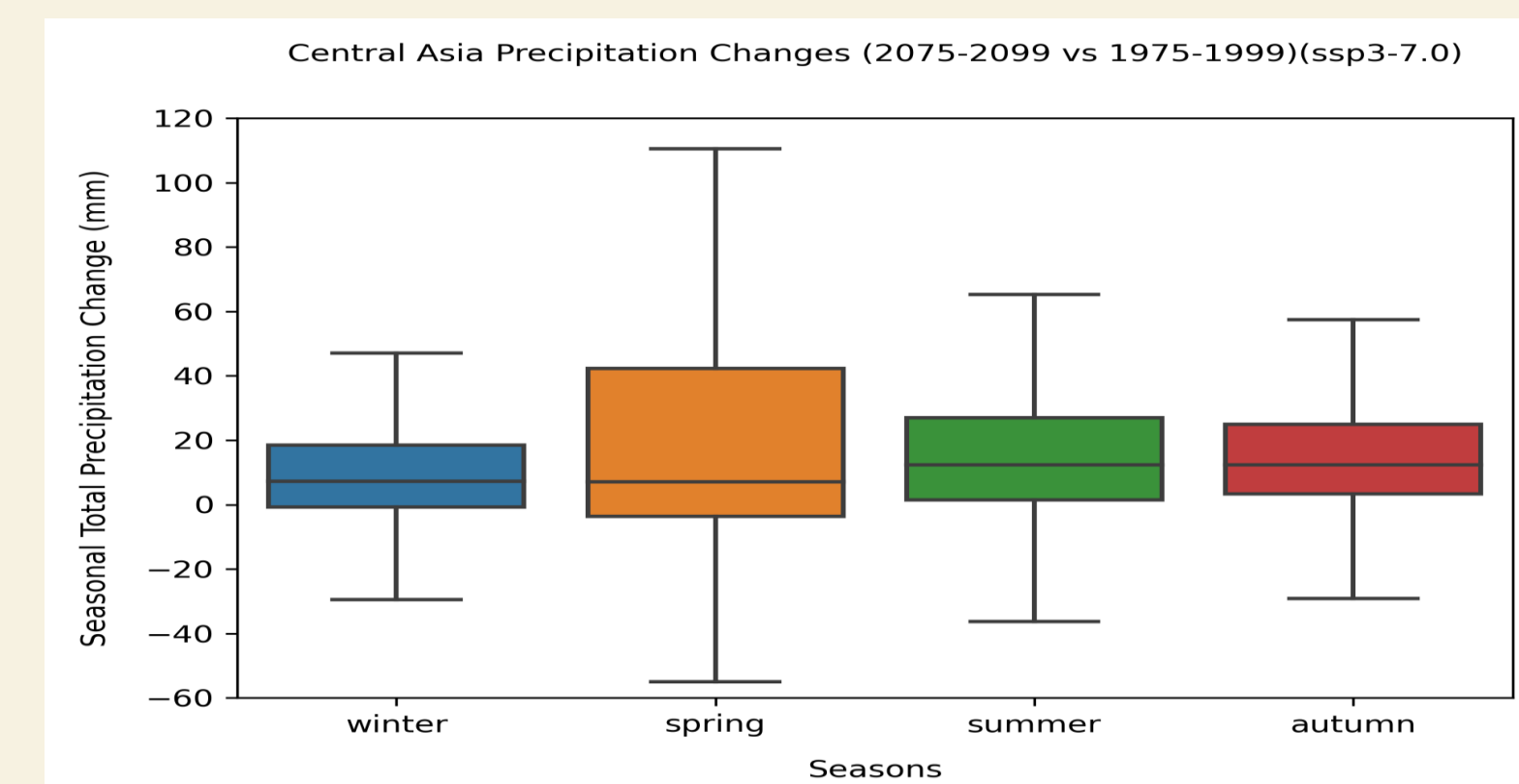


Figure 13. Projected change in total precipitation in the future period of 2075-2099 for Central Asia and SSP3-7.0 scenario compared to the 1975-1999 reference period.