RESPONSE TO TOPIC EDITOR

egusphere-2025-4258

Soil Organic Carbon Projections and Climate Adaptation Strategies across Pacific Rim Agro-ecosystems

Topic editor's comments:

I am more than a bit uncomfortable with the use of SSP5-8.5 climate scenario. It is now abundantly clear that any projections derived from it are unrealistic. The reviewers did not question this, but see below for my reasoning. Perhaps the higher-up editors will disagree with me. Anyway, I hope the authors reconsider the use of SSP5-8.5.

SSP5-8.5 is utterly unrealistic and should never be used. See for a popular explanation https://issues.org/climate-change-scenarios-lost-touch-reality-pielke-ritchie/, for a more academic analysis Scafetta, N. (2024). Impacts and risks of "realistic" global warming projections for the 21st century. Geoscience Frontiers, 15(2), 101774. https://doi.org/10.1016/j.gsf.2023.101774. Roger Pielke Jr. (https://substack.com/@rogerpielkejr) has explained this in detail.

Scafetta et al. "the high/extreme emission scenarios SSP3-7.0 and SSP5-8.5 are to be rejected because judged to be unlikely and highly unlikely, respectively. Yet, the IPCC AR6 mostly focused on such alarmistic scenarios for risk assessments." ... Why this is so unrealistic: it assumes expanding use according to a completely unrealistic projection."

Further, SSP5-8.5 has already proven to be wrong... the graph of emissions is no where near what was projected even up to now. And countries are transitioning fast away from coal -- China is building 46 nuclear energy plants and has massive solar and geothermal projects.

Response:

We appreciate the opportunity to revise our manuscript "*Soil Organic Carbon Projections and Climate Adaptation Strategies across Pacific Rim Agro-ecosystems*" for consideration in "SOIL". We thank topic editor for his kind suggestions and in-depth comments, which have greatly improved the manuscript.

We appreciate the topic editor's helpful suggestion. After careful consideration, we agree that the suggested revisions have substantially improved the quality of the paper. **Therefore, we have removed all results and discussion regarding SSP5-8.5 climate scenario from the manuscript including Figs and Tables**. Below, we provide point-by-point responses to the reviewer's comments and suggestions. All revisions related to SSP5-8.5 and minor typos have been made in the manuscript.

1. Line 28:

   Previous line: Under SSP1-2.6, SOC stocks were projected to decline by up to 20.9%, especially in uplands, due to erosion driven by extreme rainfall (R95p, R99p).

Revised line: Under scenario SSP1-2.6, SOC stocks were projected to decline by up to 20.9%, especially in uplands, due to erosion driven by extreme rainfall (R95p, R99p).

2. Line 30-31:

   Previous line: In contrast, SSP2-4.5 and SSP5-8.5 predicted SOC stock increases of 7.9% and 58%, respectively, particularly in mountainous areas where higher TNx and TXx enhanced productivity.

   Revised line: In contrast, scenario SSP2-4.5 predicted SOC stock increases of 7.9%, particularly in mountainous areas where higher TNx and TXx enhanced productivity.

3. Line 66-67:

   Previous line: Two major approaches are

   Revised line: There are two major approaches, including:

4. Line 99:

   Previous line: under different emission scenarios (SSP1-2.6, SSP2-4.5, and SSP5-8.5) and various extreme climate indicators projected for 2050 and 2100.

   Revised line: under different emission scenarios (SSP1-2.6 and SSP2-4.5) and various extreme climate indicators projected for 2050 and 2100.

5. Line 165-166:

   Previous line: The original resolution of these data was 1 km. The climatic variables, including mean annual temperature and total annual precipitation, were originally at a spatial resolution of 1 km.

   Revised line: The original spatial resolution of these data was 1 km.

6. Line:258-259

   Previous line: specifically for scenarios SSP1-2.6, SSP2-4.5, and SSP5-8.5.

   Revised line: specifically for scenarios SSP1-2.6 (sustainable development) and SSP2-4.5 (middle of the road).

7. Line 289:

   Previous line: the indicators improved to $R^2 = 0.48$ and RMSE = 0.42 for the Cubist model

Revised line: the indicators improved to $R^2 = 0.48$ and RMSE = 0.50 for the Cubist model

8. Line 315:

Previous line: A reduction in SOC stock from mountainous areas to plain areas (lowlands) was found for both watersheds.

Revised line: A reduction in SOC stock from mountainous areas to lowland areas (plain areas) was found for both watersheds.

9. Line 338:

Previous line: whereas the highest average SOC stock was identified in mountainous areas

Revised line: whereas the highest average SOC stock was identified in forest areas

10. Line 341:

Previous line: In terms of landscape type, the highest SOC stock was identified in mountainous areas

Revised line: In terms of land cover, the highest SOC stock was identified in forest areas

11. Line 345:

Previous line: 3.7 Extreme climate index parameter estimates in three emission scenarios

Revised line: 3.7 Extreme climate index parameter estimates in two emission scenarios

12. Line 346-347

Previous line: Extreme climate indices in three SSPs were compared: SSP1-2.6 (sustainable development), SSP2-4.5 (middle of the road), and SSP5-8.5 (fossil-fuel-based development).

Revised line: Extreme climate indices in two SSPs were compared: SSP1-2.6 (sustainable development) and SSP2-4.5 (middle of the road).

13. Line 348-350

Previous line: These units were classified as whole area, lowlands, uplands, and mountainous areas, denoted W, L, U, and F, respectively, in Tables S1 and S2.

Revised line: These units were classified as total area, lowlands, uplands, and mountainous areas, denoted as T, L, U, and M, respectively, in Tables S1 and S2.

14. Line 352:

Deleted line: , particularly under high-emission conditions

15. Line 353-359:

Previous line: In mountainous areas in both watersheds, significant SOC accumulation was predicted. Areas with an SOC accumulation value of >15 Mg C ha−1 were expected to exhibit an increase in SOC accumulation from <5% (2020, baseline) to more than 25% by 2100 in scenario SSP5-8.5. By contrast, lowland agricultural zones are expected to maintain relatively low SOC stocks (<9 Mg C ha^{-1}), with minor gains across scenarios. Scenario SSP5-8.5 was found to result in the greatest projected increase in SOC stocks as a result of elevated CO2 and potential biomass input, although spatial disparities are expected to increase, particularly in erosion-prone or intensively cultivated lands (Fig. S3).

Revised line: In mountainous areas in both watersheds, significant SOC accumulation was predicted. By contrast, lowland agricultural zones are expected to maintain relatively low SOC stocks (<9 Mg C ha^{-1}), with minor gains across scenarios. Scenario SSP2-4.5 was found to result in the higher projected increase in SOC stocks as a result of elevated CO2 and potential biomass input, although spatial disparities are expected to increase, particularly in erosion-prone or intensively cultivated lands (Fig. S3).

16. Line 361-362:

Previous line: In all SSPs, the increases in temperature- and precipitation-related extremes in the two watersheds were significant. In scenario SSP5-8.5, the magnitude and spatial heterogeneity of these changes were predicted to intensify toward 2100 compared to the 2020 baseline (Fig. 6a).

Revised line: In both SSPs, the increases in temperature- and precipitation-related extremes in the two watersheds were significant. In scenario SSP2-4.5, the magnitude and spatial heterogeneity of these changes were predicted to intensify toward 2100 compared to the 2020 baseline (Fig. 6a).

17. Line 364-366:

Previous line: In the ZRW, scenario SSP5-8.5 was predicted to result in a prominent increase in CDD, especially by 2100, with uplands and forest areas projected to experience CDD increases of 145% and 188%, respectively (Table S1). By contrast, for scenario SSP1-2.6, the CDD was predicted to decrease slightly by 26.3%, particularly in lowlands and plains.

Revised line: In the ZRW, scenario SSP2-4.5 was predicted to result in a 36% increase in CDD, especially by 2050 in mountainous areas (Table S1). For scenario SSP1-2.6, the CDD was predicted to decrease slightly by 26.3% and 35.2%, particularly in lowlands and uplands.

18. Line 370-371:

Previous line: These results indicated the polarization of wet–dry periods, particularly under high-emission conditions.

Revised line: These results indicated the polarization of wet–dry periods.

19. Line 371-379

Previous line: A major increase in rainfall extremes was predicted, with R95p increasing by 1558 mm in the ZRW (entire area, scenario SSP5-8.5 for the year 2100) (Table S1; S2). For the same scenario and time frame, R99p was predicted to reach 3829 mm, with uplands and forests receiving rainfall of 2634 and 2250 mm, respectively. Temperature extremes were also predicted to increase, especially in scenario SSP5-8.5. Regarding the ZRW, TXx was predicted to increase by up to 32.5% in mountainous areas (scenario SSP5-8.5 for the year 2100), whereas TNx was predicted to increase by 76.6% in uplands, indicating pronounced warming.

Revised line: A major increase in rainfall extremes was predicted, with R95p increasing by 1785 mm and 1889 mm in the total and mountainous areas, respectively, under the scenario SSP2-4.5 by 2100 in the ZRW. For the same scenario and time frame, R99p was predicted to reach 3535 mm in total areas, with uplands and mountainous areas receiving rainfall of 3625 and 3588 mm, respectively. Temperature extremes were also predicted to increase, where the TXx in ZRW was predicted to increase by up to 22.7% in mountainous areas (scenario SSP1-2.6 and SSP2-4.5 for the year 2100), whereas TNx was predicted to increase by 53.7% in mountainous areas under the scenario SSP2-4.5 by 2100, indicating pronounced warming.

20. Line 382-390

Previous line: For scenario SSP5-8.5, an approximately 211% CDD increase for the entire watershed was predicted by 2100 (Table S2), with the largest increase predicted for mountainous areas (236%). In these mountainous areas, R95p and R99p were predicted to reach 772.8 and 2442 mm, respectively. Moreover, CWD was predicted to increase in uplands by up to 85.7%, suggesting prolonged wet conditions. Notably, TXx and TNx were predicted to substantially increase in highlands and forests, reaching up to 34.7% and 83.0%, respectively, emphasizing the intensification of heat extremes. Overall, this scenario may present another type of threat: long-term droughts with torrential downpours and extreme heat.

Revised line: For scenario SSP1-2.6, an approximately 22.2% CDD increase for the entire watershed was predicted by 2100 (Table S2), with the largest increase predicted for lowland areas (52.9%). In the mountainous areas, R95p and R99p under scenario SSP2-4.5 were predicted to reach 1142 mm and 3525 mm, respectively, by 2100. Moreover, CWD was predicted to increase in uplands by up to 85.7%, suggesting prolonged wet conditions. Notably, under the same scenario and time, TXx and TNx were predicted to substantially increase in uplands and mountainous areas, reaching up to 26.8% and 62.6%, respectively, emphasizing the intensification of heat extremes. Overall, this scenario may present another type of threat: long-term droughts with torrential downpours and extreme heat.

21. Line 395:

Previous line: distribution characteristics for three scenarios

Revised line: distribution characteristics for two scenarios

22. Line 399-406:

Previous line: Regarding scenario SSP2-4.5, SOC stock variation exhibited a positive correlation with CWD ($r = 0.21$, $p < 0.05$; Fig. 8c and 8d), indicating that stable wet conditions may promote SOC accumulation under moderate emission conditions. Regarding scenario SSP5-8.5, SOC stock variation was not significantly correlated with most of the extreme climate indicators, indicating that SOC responses may be influenced by complex interactions under strong emission conditions (Fig. 8e and 8f). For all scenarios, strong positive R95p–R99p and TXx–TNx correlations were found (e.g., $r = 0.87$ between R95p and R99p in scenario SSP5-8.5). Taken together, these findings suggest uniform increases in the frequencies of extreme rainfall and extreme heat events in terms of both spatial distribution and climatic mechanisms.

Revised line: Regarding scenario SSP2-4.5, SOC stock variation exhibited a positive correlation with R95p and R99p with $r = 0.17$ and $r=0.18$, ($p < 0.05$), respectively (Fig. 8c and 8d), indicating that stable wet conditions may promote SOC accumulation under moderate emission conditions. For all scenarios, strong positive R95p–R99p and TXx–TNx correlations were found (e.g., $r = 0.93$ between R95p and R99p in scenario SSP2-4.5). Taken together, these findings suggest uniform increases in the frequencies of extreme rainfall and extreme heat events in terms of both spatial distribution and climatic mechanisms.

23. Line 408-415:

Previous line: For scenario SSP1-2.6, SOC stocks were projected to decrease by 3% to 21%, whereas for scenarios SSP2-4.5 and SSP5-8.5, SOC stocks were projected to increase by 7.91% to 58.3%, particularly in mountainous areas (because of their enhanced net primary productivity). In addition, the variance and coefficient of variation (CV) of SOC stock percentages show a significant increase in interquartile range and CV over time under moderate (SSP1-2.6, SSP2-4.5) and high (SSP5-8.5) emission scenarios relative to the 2020 baseline. For both the moderate-emission (SSP1-2.6 and SSP2-4.5) and high-emission

(SSP5-8.5) scenarios, the variance and coefficient of variation of the SOC stock percentage distribution were predicted to increase (Table 3).

Revised line: For scenario SSP1-2.6, SOC stocks were projected to decrease by 3% to 21%, whereas for scenarios SSP2-4.5, SOC stocks were projected to increase by 7.91% to 58.3%, particularly in mountainous areas (because of their enhanced net primary productivity). In addition, the variance and coefficient of variation (CV) of SOC stock percentages show a significant increase in interquartile range and CV over time under SSP1-2.6 and SSP2-4.5 emission scenarios relative to the 2020 baseline. For both emission scenarios, the variance and coefficient of variation of the SOC stock percentage distribution were predicted to increase (Table 3).

24. Line 417:

Deleted line: particularly in scenario SSP5-8.5,

Revised line: In the majority of scenarios, uplands and mountainous areas

25. Line 434

Previous line: Regarding scenarios SSP2-4.5 and SSP5-8.5

Revised line: Regarding scenarios SSP2-4.5,

26. Line 521-524:

Previous line: In slope lands, the rice fields in the two basins had SOC stock levels similar to those observed for plains, although an increase was discovered for orchard and mountainous lands. In mountainous areas, the SOC stock predictions were higher than those for plains and slope lands across all types of land cover.

Revised line: In uplands, the rice fields in the two basins had SOC stock levels similar to those observed for lowlands, although an increase was discovered for orchard and forests. In mountainous areas, the SOC stock predictions were higher than those for lowlands and uplands across all types of land cover.

27. Line 536:

Previous line: (scenarios SSP1-2.6, SSP2-4.5, and SSP5-8.5)

Revised line: (scenarios SSP1-2.6 and SSP2-4.5)

28. Line 567-568:

Previous line: In contrast to previous findings, our results indicate that SOC stocks will likely increase by an average of 45.4% to 58.3% in the study area.

They will even exceed 200% in certain mountainous areas in scenario SSP5-8.5 (Fig. 7c).

Revised line: In contrast to previous findings, our results indicate that SOC stocks will likely increase by an average of 14.2% to 35.5% in the total study area under scenario SSP2-4.5 (Fig. 7c).

29. Line 577-579

Previous line: In the high-emission scenario, severe warming and prolonged droughts in mountainous areas may result in wildfires or drought-induced dieback, which may reverse previous carbon gains in cases of ecological equilibrium within forests.

Revised line: Based on the SSP1-2.6 and SSP2-4.5 emission scenarios, severe warming and prolonged droughts in mountainous areas may result in wildfires or drought-induced dieback, which may reverse previous carbon gains in cases of ecological equilibrium within forests.

30. Line581-583:

Previous line: Although an increase in SOC stocks is projected for scenario SSP5-8.5, some uplands will experience clear losses in SOC stocks.

Revised line: Although a slight increase in SOC stocks was projected on the emission scenarios, some uplands will experience clear losses in SOC stocks.

31. Line 589-591:

Previous line: For scenario SSP5-8.5, the interaction between the Birch effect and erosion may be the reason underlying the losses predicted in SOC stocks in uplands (Birch, 1958; Schimel et al., 2007). In terms of strategies for adaptation in scenario SSP5-8.5, firebreak corridors or buffer zones in mountainous areas and drainage constructions in uplands should be prioritized.

Revised line: In terms of strategies for adaptation to temperature extremes, firebreak corridors or buffer zones in mountainous areas and drainage constructions in uplands should be prioritized.

32. Line 604-606:

Previous line: However, several studies have highlighted that SSP5-8.5 is increasingly regarded as an implausible scenario for future climate projections, and the likelihood of such a trajectory materializing could be negligible (Pielke & Ritchie, 2021; Burgess et al., 2021). Originally designed as a high-end "stress test" pathway, SSP5-8.5 assumes exceptionally high fossil-fuel use, rapid population growth, and minimal mitigation—conditions that diverge significantly from current global trends in energy transition, technology adoption, and policy implementation. Therefore, in this study, SSP5-8.5 is included only as a computational benchmark to illustrate the response of soil carbon dynamics under an extreme forcing scenario, rather than as a realistic projection of the future.

Revised line: Ultimately, these findings highlight the importance of topography, climate, and land type as essential factors for improving SOC predictions and guiding carbon management planning.

33. Line 608:

    Previous word: R2

    Revised word: R^2

34. Line 615:

    Previous line: Under a severe emissions scenario,

    Revised line: Under a moderate emissions scenario,

35. Line 619-621:

    Previous line: However, in the moderate- and high-emission scenarios (scenarios SSP2-4.5 and SSP5-8.5), warming (TNx and TXx) and extreme rainfall events (R95p and R99p) may simultaneously increase biomass input and increase soil erosion risks.

    Revised line: However, in the moderate emission scenarios (scenario SSP2-4.5), warming (TNx and TXx) and extreme rainfall events (R95p and R99p) may simultaneously increase biomass input and increase soil erosion risks.

36. Line 623:

    Previous line: In mountainous areas (mountainous areas)

    Revised line: In mountainous areas

Deleted references:

Birch, H. F.: The effect of soil drying on humus decomposition and nitrogen availability, Plant and Soil, 10, 9–31, https://doi.org/10.1007/BF01343734, 1958.

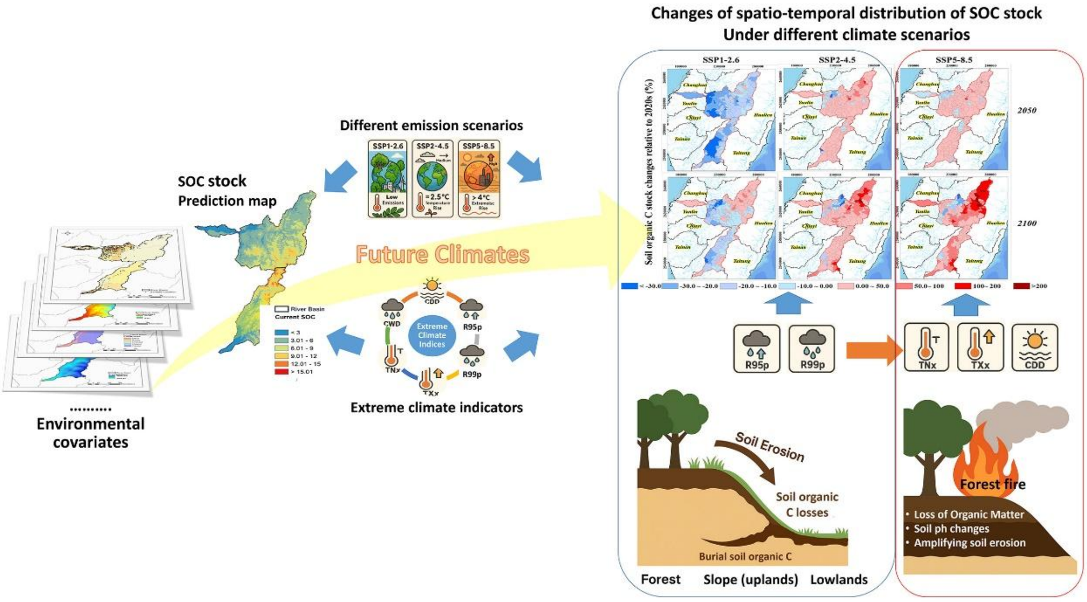
Burgess, G. M., Ritchie, J., Shapland, J., and Pielke Jr. Roger,: IPCC baseline scenarios have over-projected CO_2 emissions and economic growth, Environmental Research Letter, 16, 014016, https://doi.org/10.1088/1748-9326/abcdd2, 2021.

Pielke Jr. Roger, and Ritchie J.: Distorting the view of our climate future: The misuse and abuse of climate pathways and scenarios, Energy Research & Social Science 72, 101890, https://doi.org/10.1016/j.erss.2020.101890. 2021.

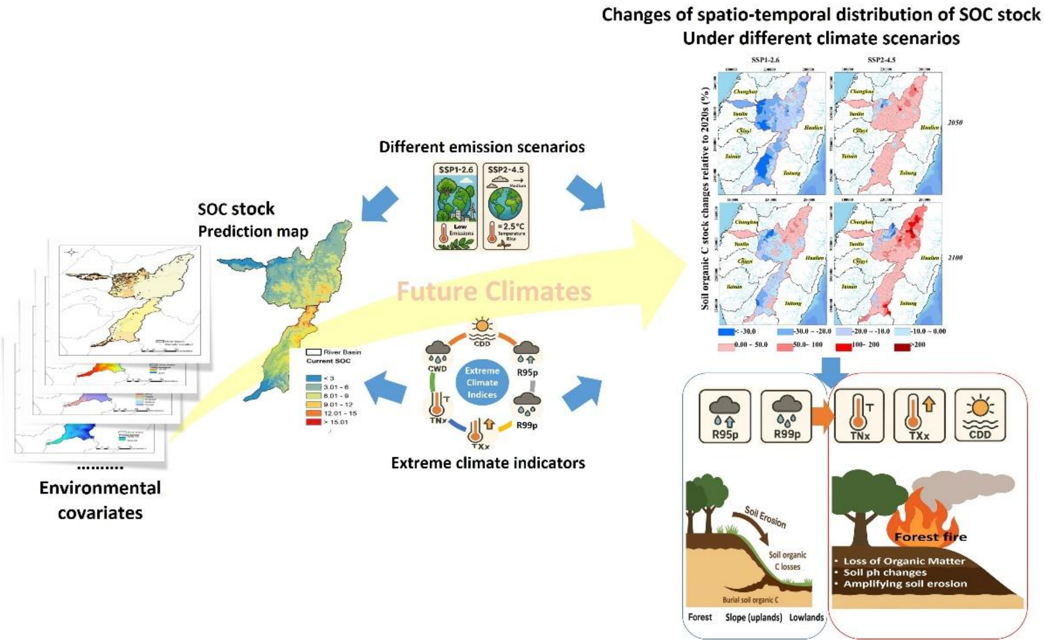
Schimel, J. P., Balser, T. C., and Wallenstein, M.: Microbial stress-response physiology and its implications for ecosystem function, Ecology, 88, 1386–1394, https://doi.org/10.1890/06-0219, 2007.

Graphical abstract:

Previous graph:



Revised graph:



Revised Tables and Figures:

1. Line 844-847

   Previous table:

Table 3. Variance and coefficient of variance (CV) of the spatiotemporal distribution of SOC stocks for various land uses in the three emission scenarios.

		2020				2050				2100			
		T	P	SL	M	T	P	SL	M	T	P	SL	M
	Variance	6.45	0.66	1.35	5.11								
	CV(%)	44.3	32.3	30.7	32.5								
SSP1 2.6	Variance					5.52	0.35	0.85	4.37	8.24	0.76	1.56	6.45
	CV(%)					50.4	29.8	33.9	36.0	51.3	33.5	39.2	36.4
SSP2 4.5	Variance					10.11	1.14	2.25	7.95	21.44	1.74	2.53	18.77
	CV(%)					48.5	35.0	37.5	34.9	59.7	35.2	40.4	43.7
SSP5 8.5	Variance					8.53	0.71	1.82	6.92	36.22	1.96	2.86	33.33
	CV(%)					47.1	31.8	33.5	34.7	65.8	34.1	40.0	48.5

CV: coefficient of variance; T: total area; P: plain regions; SL: slope land regions; M: Mountainous.

Revised table:

Table 3. Variance and coefficient of variance (CV) of the spatiotemporal distribution of SOC stocks for various land uses in the two emission scenarios.

		2020				2050				2100			
		T	L	U	M	T	L	U	M	T	L	U	M
	Variance	6.45	0.66	1.35	5.11								
	CV(%)	44.3	32.3	30.7	32.5								
SSP 1 2.6	Variance					5.52	0.35	0.85	4.37	8.24	0.76	1.56	6.45
	CV(%)					50.4	29.8	33.9	36.0	51.3	33.5	39.2	36.4
SSP 2 4.5	Variance					10.1	1.14	2.25	7.95	21.4	1.74	2.53	18.7
	CV(%)					48.5	35.0	37.5	34.9	59.7	35.2	40.4	43.7

CV: coefficient of variance; T: total area; L: lowland regions; U: Upland regions; M: Mountainous regions.

2. Line 869-874:

Previous figure:

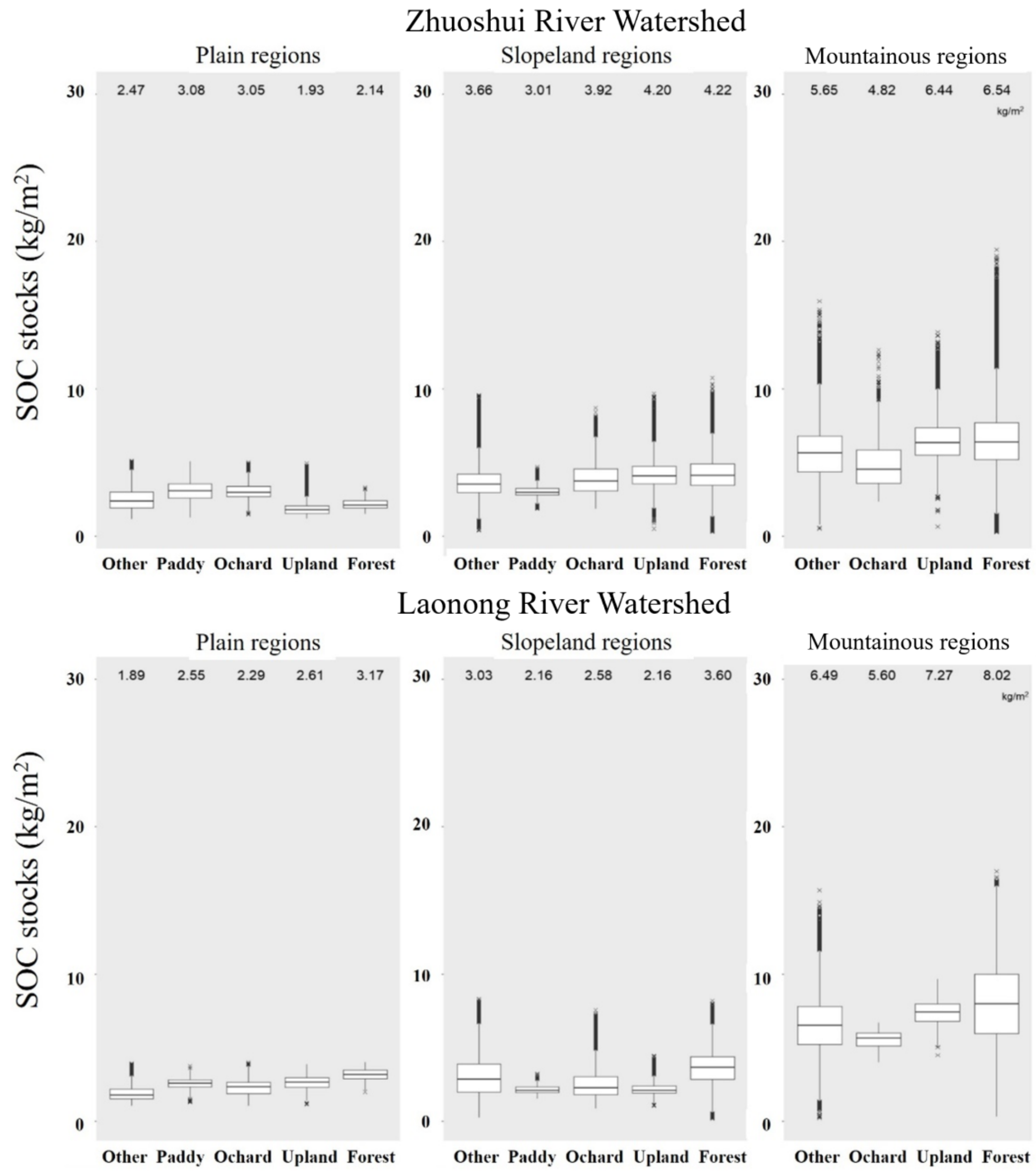


Fig. 5. Boxplots of topsoil (0–30 cm) soil organic carbon (SOC) stocks for various land cover: (left) plain regions (<100 m in elevation), (middle) slopeland regions (100–1000 m in elevation), and (right) Mountainous regions (>1000 m in elevation) at Zhuoshui River watershed and Laonong River watershed. The upland land cover represents the upland farming.

Revised figure:

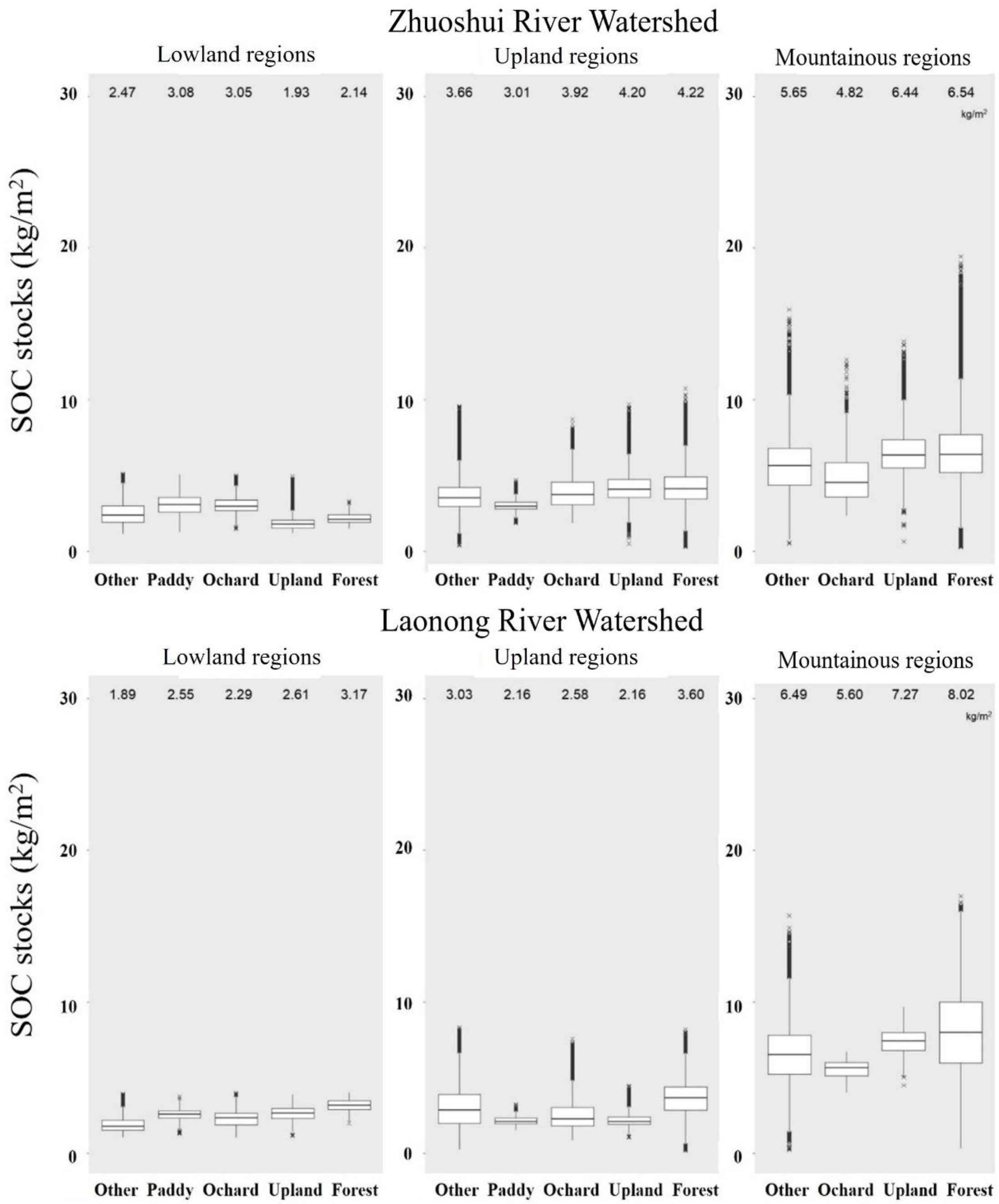


Fig. 5. Boxplots of topsoil (0–30 cm) soil organic carbon (SOC) stocks for various land cover: (left) lowland regions (<100 m in elevation), (middle) upland regions (100–1000 m in elevation), and (right) mountainous regions (>1000 m in elevation) at Zhuoshui River watershed and Laonong River watershed. The upland land cover represents the upland farming.

3. Line 875-878:

Previous figure:

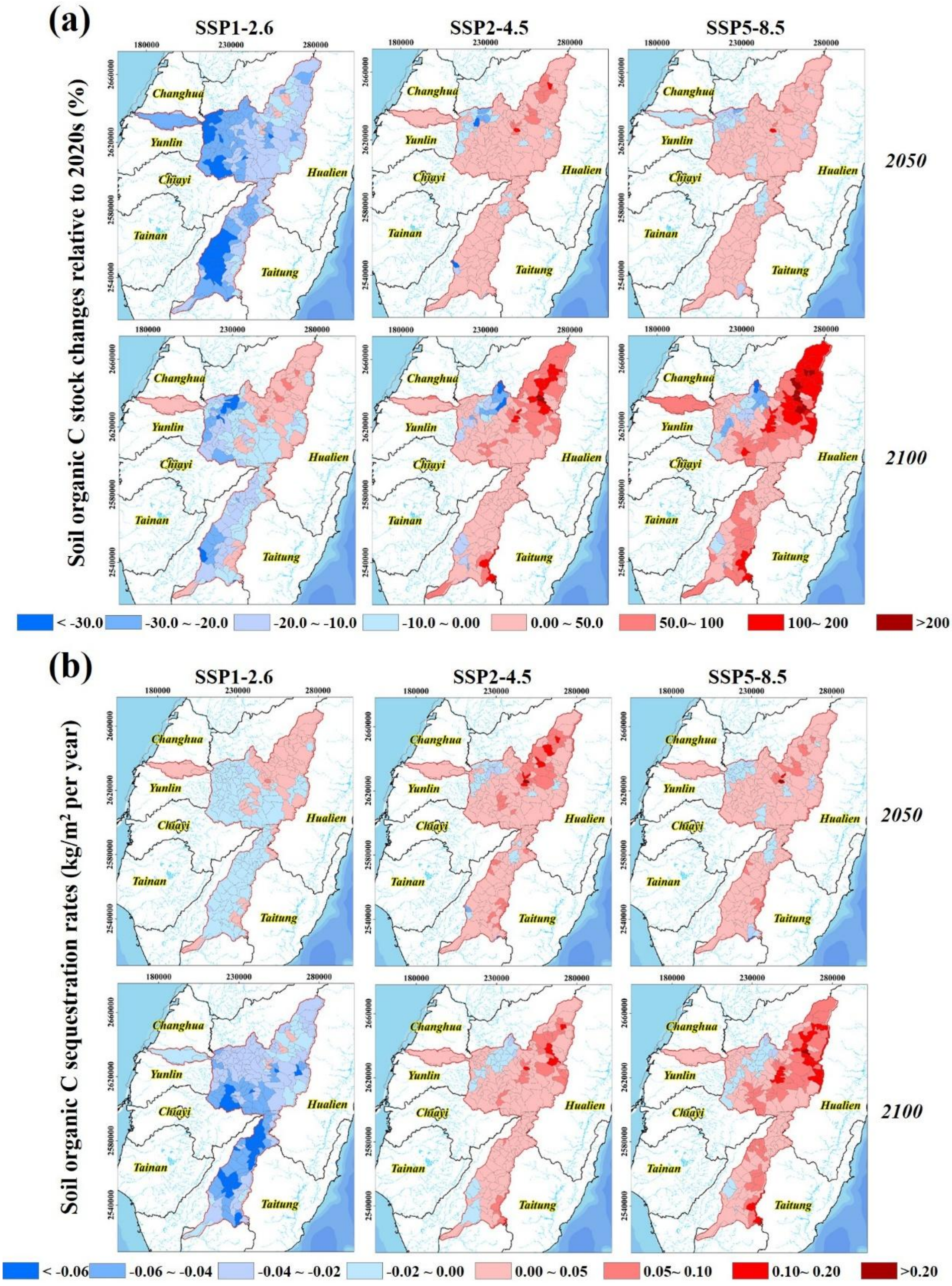


Fig. 6. Spatiotemporal predictions of (a) SOC stocks (kg m^{-2}) and (b) SOC sequestration rates (kg m^{-2} per year) relative to the 2020s under three emission scenarios. The mapping unit is sub-catchments in Taiwan

Revised figure:

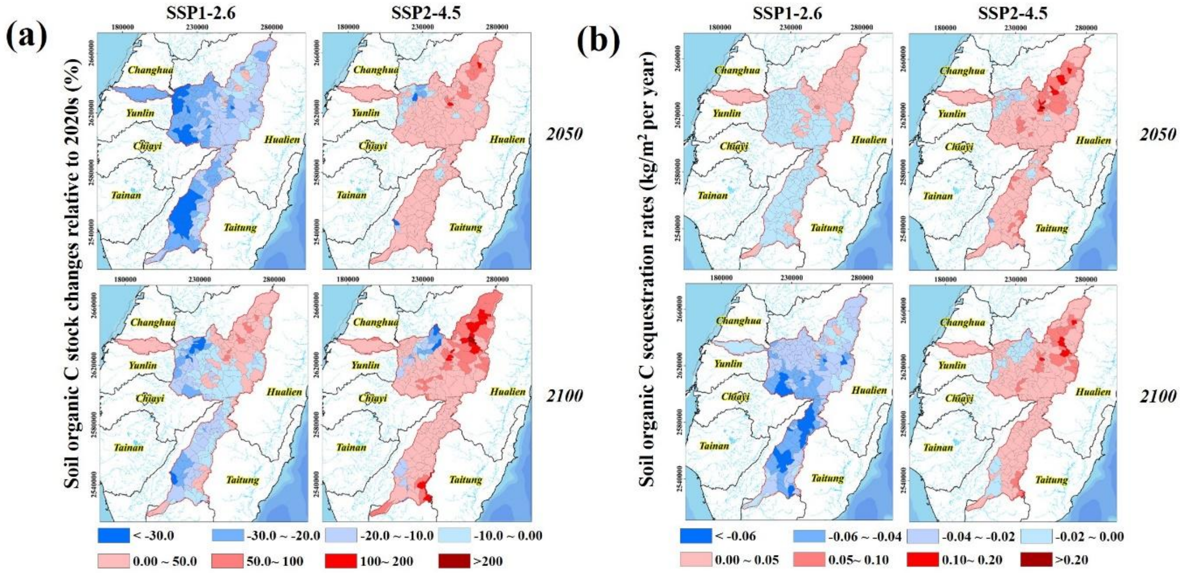


Fig. 6. Spatiotemporal predictions of (a) SOC stocks (kg m^{-2}) and (b) SOC sequestration rates (kg m^{-2} per year) relative to the 2020s under two emission scenarios. The mapping unit is sub-catchments in Taiwan.

4. Line 879-883

Previous figure:

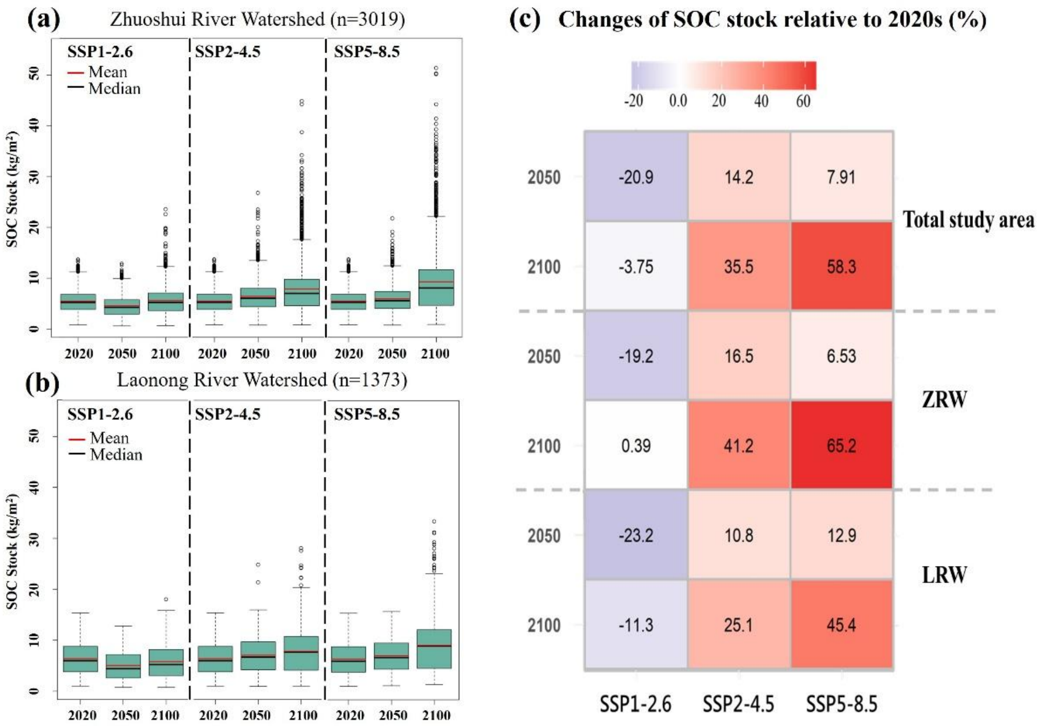


Fig. 7. Boxplots showing the temporal trends in predicted SOC stocks across three emission scenarios (SSP1-2.6, SSP2-4.5, and SSP5-8.5) for 2020, 2050, and 2100 in (a) Zhuosui River watershed; and (b) Laonong River watershed, and (c) Increase in the ratio of SOC stocks relative to the 2020s in the ZRW and LRW for the three emission scenarios for 2050 and 2100.

Revised figure:

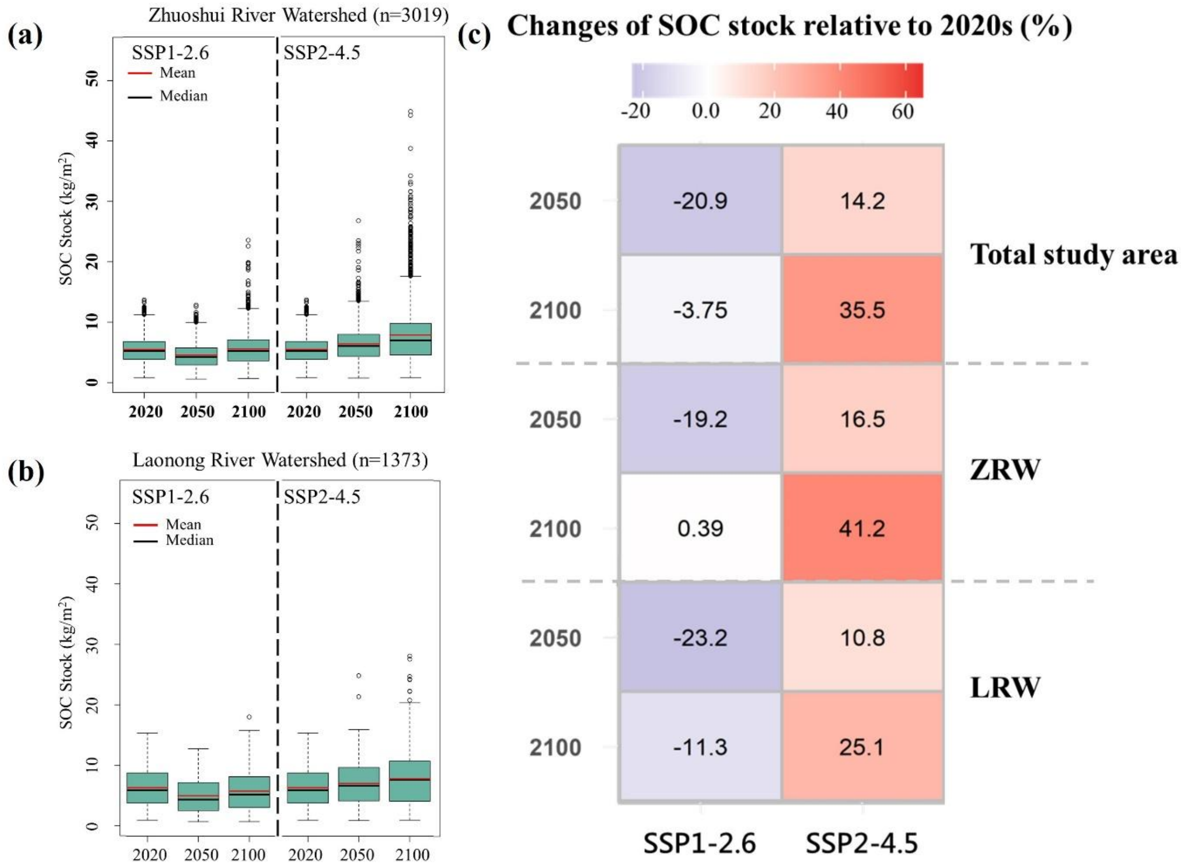


Fig. 7. Boxplots showing the temporal trends in predicted SOC stocks across two emission scenarios (SSP1-2.6 and SSP2-4.5) for 2020, 2050, and 2100 in (a) Zhuosui River watershed; and (b) Laonong River watershed, and (c) Increase in the ratio of SOC stocks relative to the 2020s in the ZRW and LRW for the two emission scenarios for 2050 and 2100.

5. Line 885-887:

Previous figure:

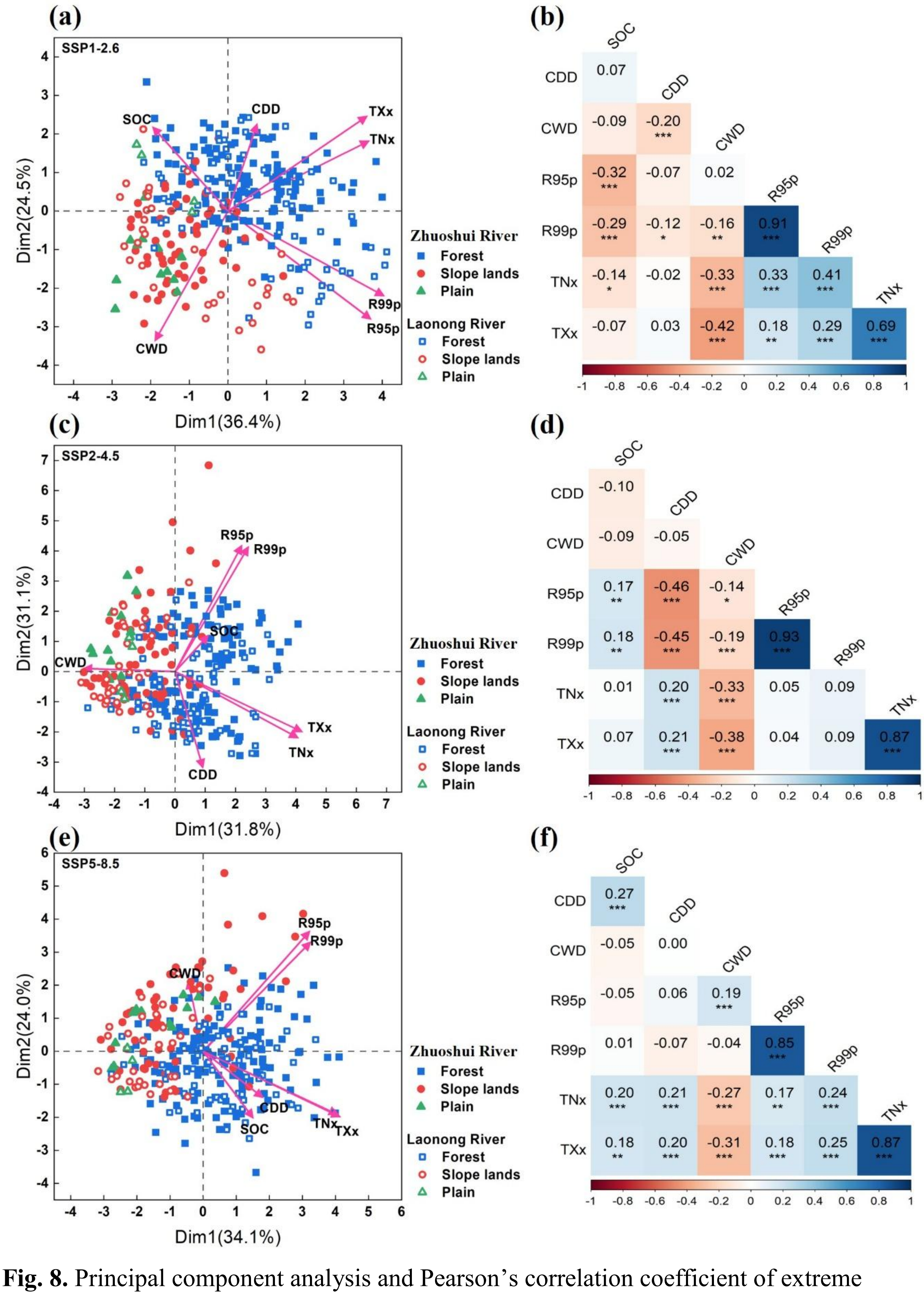


Fig. 8. Principal component analysis and Pearson's correlation coefficient of extreme climate indices and SOC stocks: (a, b) SSP1-2.6, (c, d) SSP2-4.5, and (e, f) SSP5-8.5.

Revised figure:

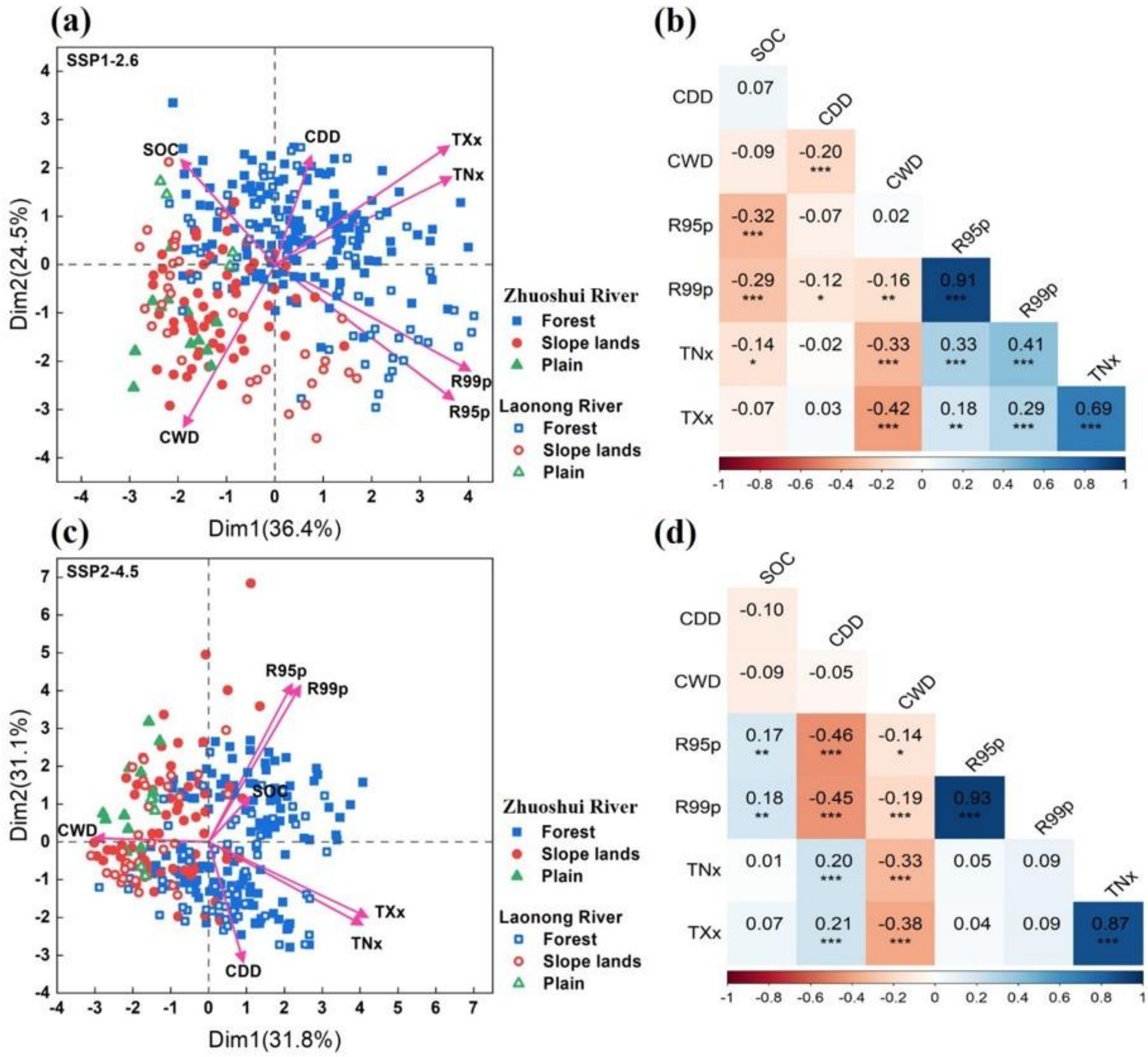


Fig. 8. Principal component analysis and Pearson's correlation coefficient of extreme climate indices and SOC stocks: (a, b) and SSP1-2.6, (c, d) SSP2-4.5

Revised supplementary files:

1. Line 6-8:

   Previous figure:

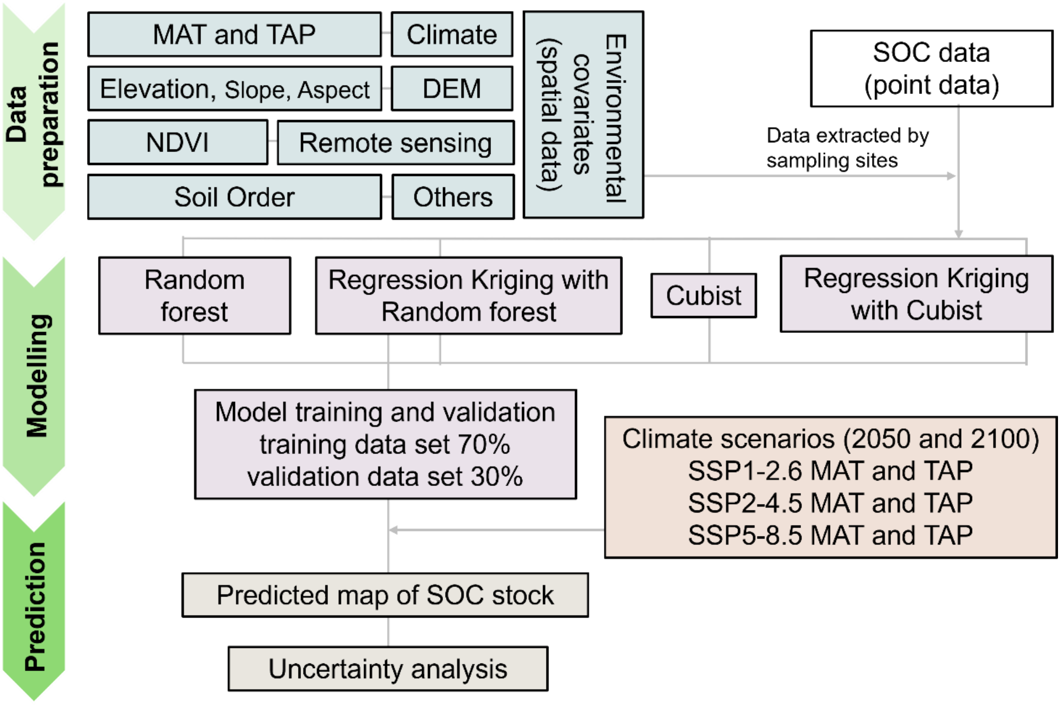


Fig. S2. Methodology flow chart of data preparation, modelling, and prediction developed in this study

Revised figure:

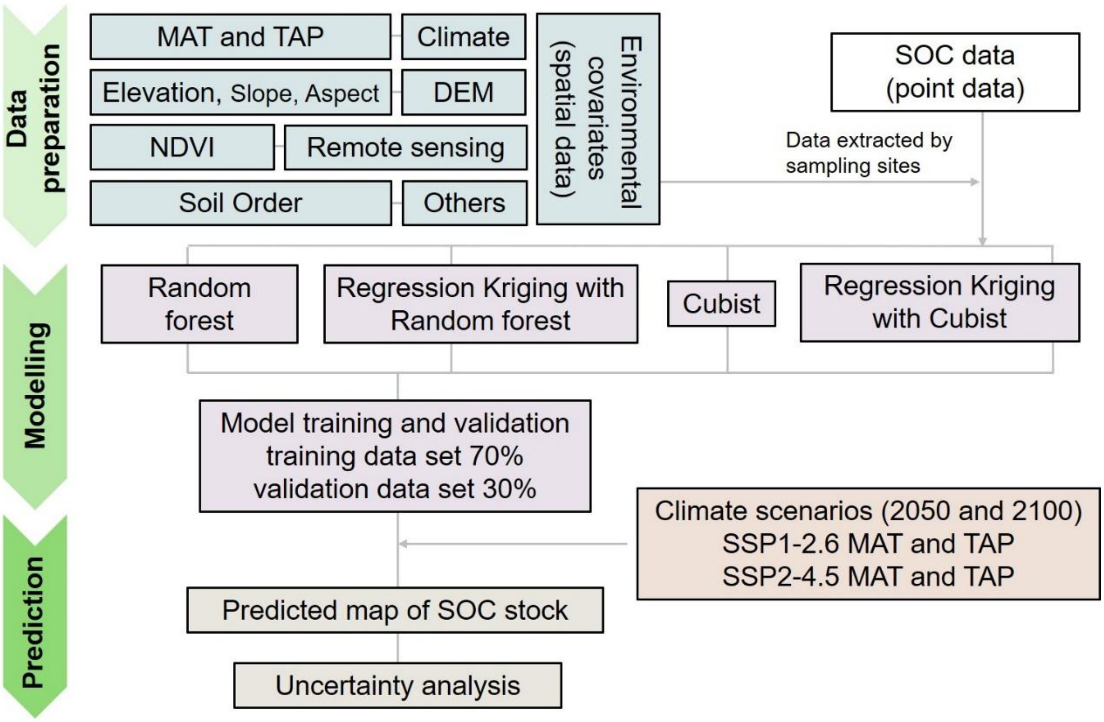


Fig. S2. Methodology flow chart of data preparation, modelling, and prediction developed in this study

2. Line 10-15

Previous figure:

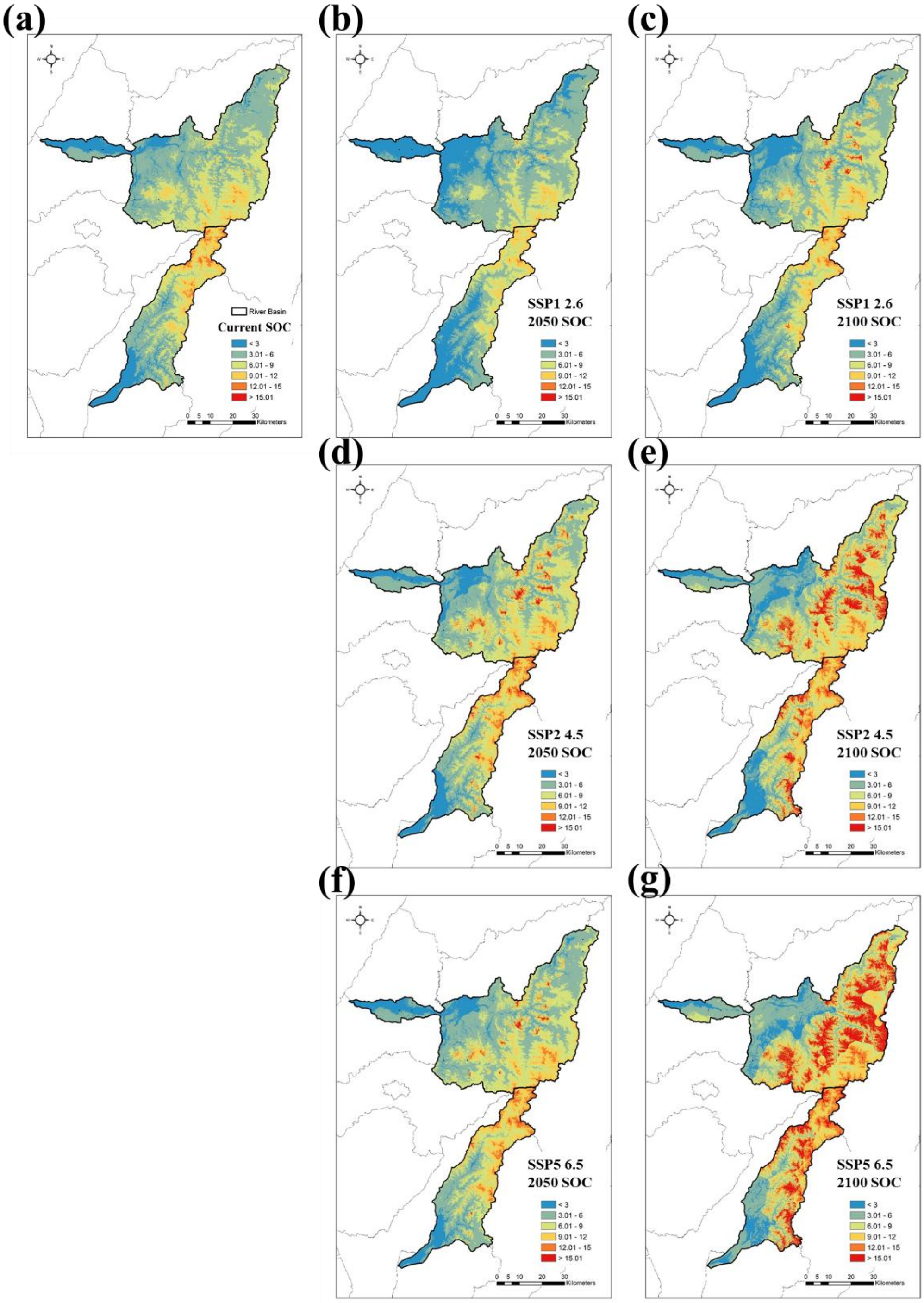


Fig. S3. Spatio-temporal distribution of SOC stock under different emission scenarios in mid-century and end- century at Zhuoshui and Laonong River watersheds: (a) SOC stock in 2020 (baseline); (b) SOC stock under SSP1-2.6 in 2050; (c)SOC stock under SSP1-2.6 in 2100; (d) SOC stock under SSP2-4.5 in 2050; (e) SOC stock under SSP2-4.5 in 20100; (f) SOC stock under SSP5-8.5 in 2050; (g) SOC stock under SSP5-8.5 in 2100.

Revised figure:

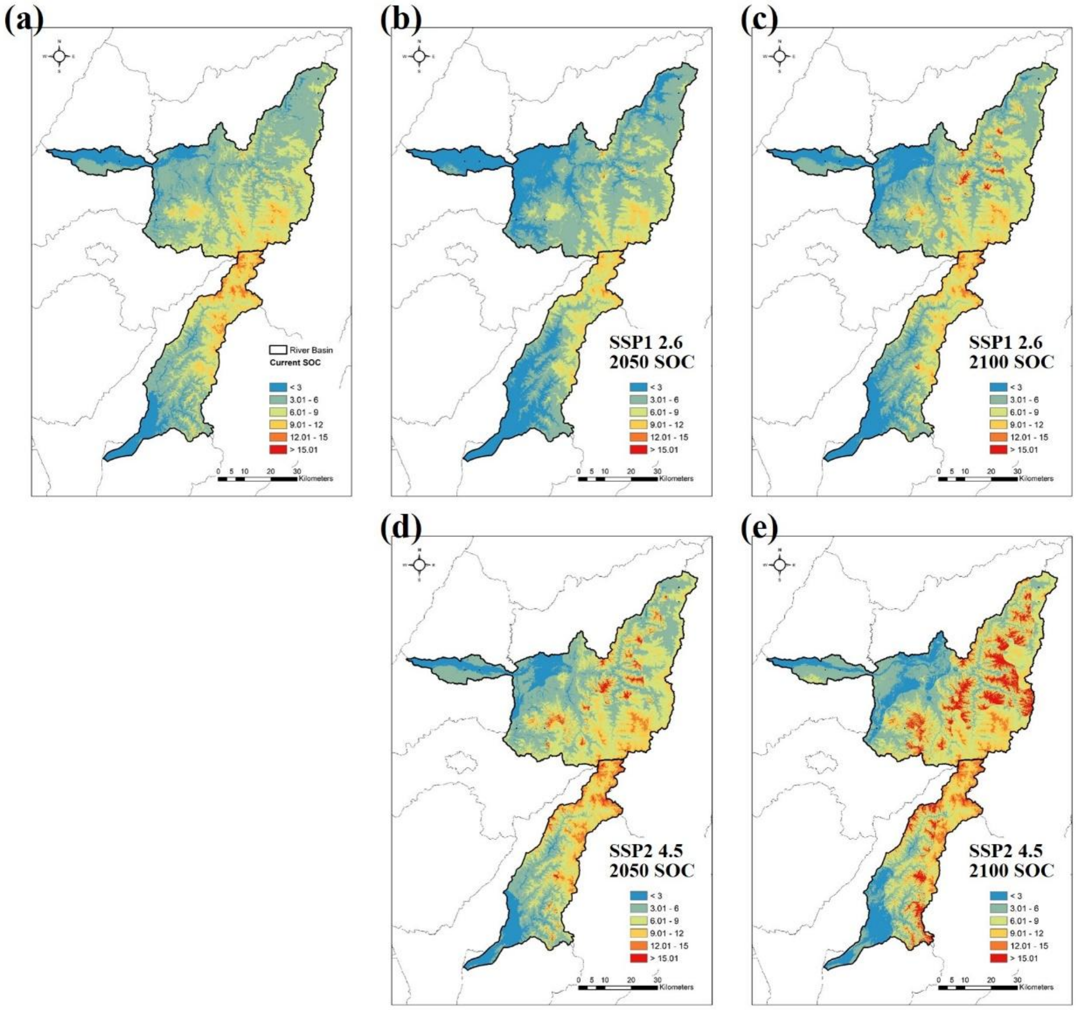


Fig. S3. Spatio-temporal distribution of SOC stock under different emission scenarios in mid-century and end- century at Zhuoshui and Laonong River watersheds: (a) SOC stock in 2020 (baseline); (b) SOC stock under SSP1-2.6 in 2050; (c)SOC stock under SSP1-2.6 in 2100; (d) SOC stock under SSP2-4.5 in 2050; (e) SOC stock under SSP2-4.5 in 2010

3. Line 17-21

Previous figure:

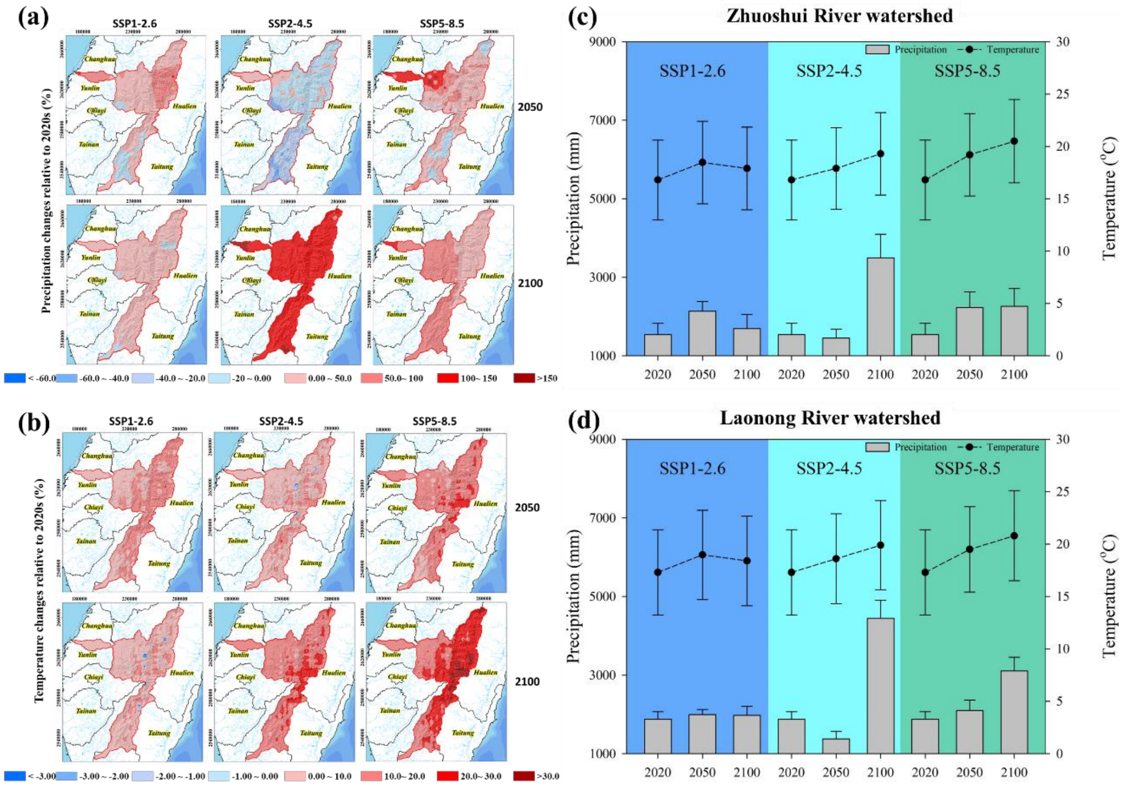


Fig. S4. Distribution of precipitation (a) and temperature (b) in 2050 and 2100 under different emission scenarios based on CMIP6 data; and the average value of temperature and precipitation of ZRW and LRW under different emission scenarios in 2020, 2050, and 2100.

Revised figure:

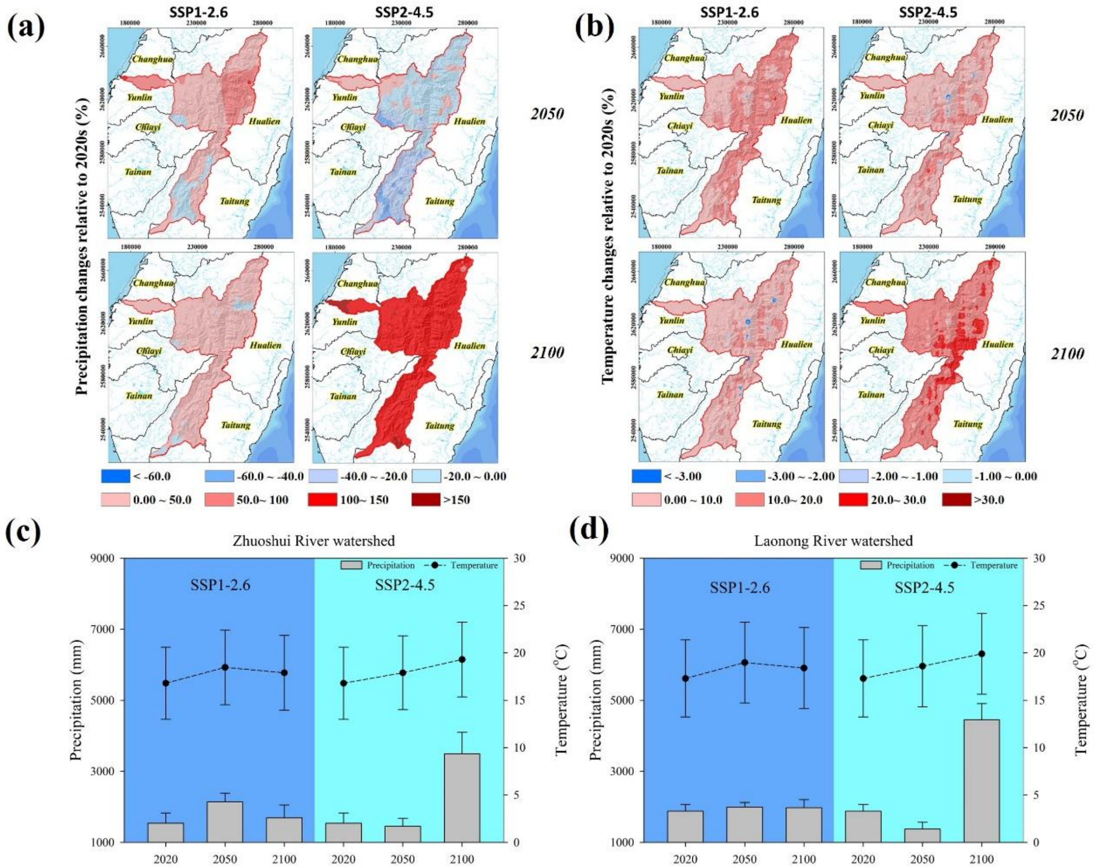


Fig. S4. Distribution of precipitation (a) and temperature (b) in 2050 and 2100 under different emission scenarios based on CMIP6 data; and the average value of temperature and precipitation of ZRW (c) and LRW (d) under different emission scenarios in 2020, 2050, and 2100.

4. Line 23-32:

   Previous table

Table S1. Change percentage of extreme climate indices at different landscapes types in 2020, 2050 and 2100 under different emission scenarios at Zhuoshui River watershed compared with baseline value (2020)

ZRW	2050				2100			
	W	L	U	F	W	L	U	F
CDD (%)								
SSP1-2.6	-10.0	-26.8	-28.9	4.00	-6.70	-35.2	-26.3	8.00
SSP2-4.5	20.0	-42.3	0.00	36.0	-20.0	-60.6	-28.9	-12.0
SSP5-8.5	33.3	-15.5	18.4	36.0	170	43.7	145	188
CWD (%)								
SSP1-2.6	9.09	140	40.0	-7.69	-9.09	140	30.0	-7.69
SSP2-4.5	9.09	60.0	20.0	-7.69	-9.09	60.0	0.00	-15.4
SSP5-8.5	0.00	100	10.0	-15.4	18.2	160	40.0	0.00
R95p (mm)								
SSP1-2.6	892.6	897.0	709.0	990.5	584.9	274.4	547.2	627.0
SSP2-4.5	260.8	0.000	112.0	346.5	1785	986.4	1699	1889
SSP5-8.5	1155	581.7	1127	1216	1355	1258	1442	1325
R99p (mm)								
SSP1-2.6	2069	666.7	1919	2163	1770	1320	1773	1820
SSP2-4.5	1324	800.3	1172	1436	3535	2552	3625	3588
SSP5-8.5	2243	1846	2371	2223	2396	2629	2634	2250
TNx (%)								
SSP1-2.6	29.8	0.64	5.63	42.6	21.9	-1.50	3.82	31.6
SSP2-4.5	44.1	11.3	18.5	57.9	40.8	9.86	16.8	53.7
SSP5-8.5	44.6	14.6	18.6	58.3	60.2	18.9	30.2	76.6
TXx (%)								
SSP1-2.6	22.3	1.36	1.66	33.0	15.8	1.00	2.81	22.7
SSP2-4.5	17.7	1.71	4.68	24.7	16.4	4.51	4.10	22.7
SSP5-8.5	18.9	4.33	3.86	26.5	24.9	10.6	9.84	32.5

W: whole area; L: lowlands; U: uplands; F: forested areas;
CDD: Consecutive dry days; CWD: Consecutive wet days; R95p: Very wet-day precipitation; R99p: Extremely wet day precipitation; TNn: minimum value of daily minimum temperature; TXx: maximum value of daily maximum temperature

Revised table:

Table S1. Change percentage of extreme climate indices at different landscape types in 2020, 2050, and 2100 under different emission scenarios at Zhuoshui River watershed compared with baseline value (2020)

ZRW	2050				2100			
	T	L	U	M	T	L	U	M
CDD (%)								
SSP1-2.6	-10.0	-26.8	-28.9	4.00	-6.70	-35.2	-26.3	8.00
SSP2-4.5	20.0	-42.3	0.00	36.0	-20.0	-60.6	-28.9	-12.0
CWD (%)								
SSP1-2.6	9.09	140	40.0	-7.69	-9.09	140	30.0	-7.69
SSP2-4.5	9.09	60.0	20.0	-7.69	-9.09	60.0	0.00	-15.4
R95p (mm)								
SSP1-2.6	892.6	897.0	709.0	990.5	584.9	274.4	547.2	627.0
SSP2-4.5	260.8	0.000	112.0	346.5	1785	986.4	1699	1889
R99p (mm)								
SSP1-2.6	2069	666.7	1919	2163	1770	1320	1773	1820
SSP2-4.5	1324	800.3	1172	1436	3535	2552	3625	3588
TNx (%)								
SSP1-2.6	29.8	0.64	5.63	42.6	21.9	-1.50	3.82	31.6
SSP2-4.5	44.1	11.3	18.5	57.9	40.8	9.86	16.8	53.7
TXx (%)								
SSP1-2.6	22.3	1.36	1.66	33.0	15.8	1.00	2.81	22.7
SSP2-4.5	17.7	1.71	4.68	24.7	16.4	4.51	4.10	22.7

T: Total areas; L: lowland areas; U: upland areas; M: mountainous areas;
CDD: Consecutive dry days; CWD: Consecutive wet days; R95p: Very wet-day precipitation; R99p: Extremely wet day precipitation; TNn: minimum value of daily minimum temperature; TXx: maximum value of daily maximum temperature

5. Line 33-42

Previous table

Table S2. Change percentage of extreme climate indices at different landscapes types in 2020, 2050 and 2100 under different emission scenarios at Zhoushui River watershed compared with baseline value (2020)

LRW	2050				2100			
	W	L	U	F	W	L	U	F
CDD (%)								
SSP1-2.6	-3.70	38.2	-9.70	-8.00	22.2	52.9	22.6	16.0
SSP2-4.5	40.7	20.6	29.0	44.0	-7.41	-14.7	-16.1	-4.00
SSP5-8.5	74.1	70.6	71.0	72.0	211	147	174	236
CWD (%)								
SSP1-2.6	44.4	30.0	85.7	20.0	44.4	-20.0	85.7	30.0
SSP2-4.5	44.4	20.0	85.7	30.0	22.2	10.0	57.1	10.0
SSP5-8.5	22.2	30.0	42.9	20.0	33.3	-20.0	71.4	30.0
R95p (mm)								
SSP1-2.6	1326	1358	1137	1491	139.1	0.000	12.24	211.1
SSP2-4.5	68.13	0.000	0.000	106.5	1096	452.5	1083	1142
SSP5-8.5	704.4	106.7	460.7	863.6	576.6	0.000	256.3	772.8
R99p (mm)								
SSP1-2.6	2865	203.8	2917	2904	1574	904.4	1581	1635
SSP2-4.5	1475	1335	1601	1422	3744	3921	4169	3525
SSP5-8.5	2404	2318	2390	2414	2195	1433	2203	2242
TNx (%)								
SSP1-2.6	32.9	7.61	4.95	48.5	1.43	-0.98	3.72	0.44
SSP2-4.5	46.9	6.90	17.7	64.1	45.5	2.59	16.4	62.6
SSP5-8.5	50.3	13.4	19.9	67.8	63.1	15.2	29.5	83.0
TXx (%)								
SSP1-2.6	20.6	5.01	0.76	31.5	15.4	-3.59	-0.48	24.5
SSP2-4.5	17.5	5.15	0.83	26.6	17.2	1.40	0.04	26.8
SSP5-8.5	20.1	3.59	2.20	30.0	24.1	0.57	5.70	34.7

W: whole area; L: lowlands; U: uplands; F: forested areas;
CDD: Consecutive dry days; CWD: Consecutive wet days; R95p: Very wet-day precipitation; R99p: Extremely wet day precipitation; TNn: minimum value of daily minimum temperature; TXx: maximum value of daily maximum temperature

Revised table:

Table S2. Change percentage of extreme climate indices at different landscape types in 2020, 2050, and 2100 under different emission scenarios at Zhoushui River watershed compared with baseline value (2020)

LRW	2050				2100			
	T	L	U	M	T	L	U	M
CDD (%)								
SSP1-2.6	-3.70	38.2	-9.70	-8.00	22.2	52.9	22.6	16.0
SSP2-4.5	40.7	20.6	29.0	44.0	-7.41	-14.7	-16.1	-4.00
CWD (%)								
SSP1-2.6	44.4	30.0	85.7	20.0	44.4	-20.0	85.7	30.0
SSP2-4.5	44.4	20.0	85.7	30.0	22.2	10.0	57.1	10.0
R95p (mm)								
SSP1-2.6	1326	1358	1137	1491	139.1	0.000	12.24	211.1
SSP2-4.5	68.13	0.000	0.000	106.5	1096	452.5	1083	1142
R99p (mm)								
SSP1-2.6	2865	203.8	2917	2904	1574	904.4	1581	1635
SSP2-4.5	1475	1335	1601	1422	3744	3921	4169	3525
TNx (%)								
SSP1-2.6	32.9	7.61	4.95	48.5	1.43	-0.98	3.72	0.44
SSP2-4.5	46.9	6.90	17.7	64.1	45.5	2.59	16.4	62.6
TXx (%)								
SSP1-2.6	20.6	5.01	0.76	31.5	15.4	-3.59	-0.48	24.5
SSP2-4.5	17.5	5.15	0.83	26.6	17.2	1.40	0.04	26.8

T: Total areas; L: lowland areas; U: upland areas; M: mountainous areas;
CDD: Consecutive dry days; CWD: Consecutive wet days; R95p: Very wet-day precipitation; R99p: Extremely wet day precipitation; TNn: minimum value of daily minimum temperature; TXx: maximum value of daily maximum temperature

We sincerely appreciate the reviewer's constructive feedback, which has greatly strengthened our manuscript. We hope that our revisions address all concerns raised and that the manuscript will now be considered suitable for publication.