This resubmitted version of the paper has addressed my previous concerns effectively, demonstrating the authors' great efforts. The manuscript now provides a clear explanation of the novel motivation behind the work, and the research results are presented in an informative manner with well-crafted plots. The first comparisons of sub-basin runoff changes in the YZ river are particularly valuable, as they contribute to a better understanding of runoff changes at the downstream basin outlet, which will likely be of great interest to other researchers.

Reply:

Thanks for the comments. At the same time, we have carefully addressed the reviewer's comments point-by-point in the revision.

Before accepting this version, I have three minor suggestions:

1. Including additional statements on the calculation of runoff composition contributions in sub-basins would enhance reader understanding of differences among the sub-basins. For instance, providing formulas such as rainfall contribution = rainfall in the sub-basin / (rainfall + snowmelt + glacier melt) generated in the sub-basin area could clarify these calculations.

Reply:

"Based on the simulation of total runoff, and its three components (rainfall runoff, snowmelt, and glacier runoff), contribution of three components to total runoff in the basin can be calculated as:

$$Total\ runoff\ (TR) = Rainfall\ runoff\ (RR) + Snowmelt\ runoff (SR) + Glacier\ runoff (GR)$$

$$Rainfall\ runoff\ contribution = \frac{RR}{TR} \times 100\%$$

$$Snowmelt\ runoff\ contribution = \frac{SR}{TR} \times 100\%$$

$Snowmelt\ runoff\ contribution = \frac{SR}{TR} \times 100\%$”

We have added it in the revision.

2. It would be beneficial to include a table summarizing the model calibration and performance to provide a more straightforward description of the calibration procedure. This table could include details such as the calibration step, model parameters calibrated in each step, data used for evaluation, objective function, and performance metrics.

Reply:

We have added a Table to summarize the model calibration and validation in each step in the revision.

“Table 1. Values of the first (D1, m), the second soil depth (D2, m) and degree-day factor (DDF), and the Nash-Sutcliffe Efficiency (NSE) and Relative Bias (RB, %) of the simulated monthly streamflow with the Variable Infiltration Capacity (VIC)-Glacier model relative to the observation for the eight hydrological stations.

Step1. Calibration and validation of the glacier model					
Sub-basin	Hydrological station	DDF ($mm°C^{-1}$ day^{-1})	Calibration (glacier area observations)	Validation (glacier mass balance)	
			RB (%)	CC	RB (%)
LZ	LZ	10.97	-1.3	0.65-0.96	-15% to -45%
LZ-YC	YC	10.97	-3.7		
RKZ	RKZ	10.97	-6.2		
LS	LS	9.2	-2		
YC-NX	NX	6.8	-1.5		
NX-BXK	YG	6.5	1.7		
	BM	6.5			
	MT	6.5			

Step2. Calibration and validation of the VIC model							
Sub-basin	Hydrological station	D1(m)	D2(m)	Calibration (observed streamflow)		Validation (observed streamflow)	
				NSE	RB (%)	NSE	RB (%)
LZ	LZ	0.1	0.7	0.85	2.1	0.81	1.8
LZ-YC	YC	0.1	0.7	0.83	3	0.81	1.6
RKZ	RKZ	0.1	0.9	0.84	-4	0.71	-8
LS	LS	0.1	0.7	0.84	-2	0.82	-2
YC-NX	NX	0.1	1	0.86	-4	0.86	-5
NX-BXK	YG	0.1	1	0.82	-8	0.83	-5
	BM	0.1	1	0.83	-6	0.83	-5
	MT	0.1	1	0.71	6	0.73	5

3. Adding an additional discussion section to explore the underlying reasons for the different runoff change trends (both historical and future) in the sub-basins would enrich the results. In this section, quantitative comparisons of changes in total precipitation, temperature, snow fraction in precipitation, evapotranspiration, and glacier mass among the sub-basins could be included to provide more insight into the observed runoff change trends.

Reply:

We have analyzed the underlying reasons for the different runoff change trends in the upper Nuxia (NX) hydrological station and downstream of the NX hydrological station (NX-BXK sub-basin). In addition, we added three tables about projected changes (%) in mean annual and seasonal total runoff and its three components (rainfall, snowmelt and glacier), precipitation and temperature in 2021–2050 and 2071–2100, respectively, relative to 1971–2000 under the two SSPs in the YZ basin and its two sub-basins.

“Increased total runoff are projected to be primarily influenced by increased rainfall

runoff, with minor contributions from increased snowmelt and glacier runoff under both SSPs scenario through the 21st century. However, in comparison to the 1971–2000 mean, a reduction of approximately -6% to -14% is projected in the first half of the 21st century (2021–2050) in the YZ and its NX and NX-BXK sub-basins under the SSP2-4.5 and SSP5-8.5 scenario (Figure 8). This reduction is attributed to decreased rainfall (-9% to -19%) and snowmelt (-5% to -6%), which may result in the decline of freshwater supply. Conversely, there is a broadly consistent increase (6%–32%) in total runoff in the second half of the 21st century (2071–2100), mainly driven by increased rainfall (4%–52%) and glacier runoff (9%–78%), suggesting that the YZ basin will not face a water supply crisis in the end of 21st century.

The increased total runoff in the NX basin is primarily attributed to increased rainfall runoff and spring snowmelt, indicating an earlier spring snow melt and delayed fall freeze-up. Similarly, the increased total runoff in the NX-BXK basin is mostly a result of increased rainfall and glacier runoff, coupled with decreased snowmelt, primarily due to reduced snowfall with ongoing warming in each month. Future changes in seasonal runoff across the entire YZ basin closely align with those in the NX-BXK sub-basin due to its significant contribution to the overall runoff of the YZ basin."

Table 2. Projected changes (%) in mean annual and seasonal total runoff and its three components (rainfall, snowmelt and glacier) in 2021–2050 and 2071–2100, respectively, relative to 1971–2000 under the two SSPs in the YZ basin and its two sub-basins. The uncertainties are indicated with one standard deviation.

Basin	Period	Variable	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
NX	2021-2050 (SSP2-4.5)	Total	-15±3	-15±3	-10±4	-7±6	-9±7	-5±7	3±7	-3±3	-11±4	-11±5	-12±3	-14±3	-6±4
		Rainfall	-15±3	-16±3	-16±3	-14±3	-1±4	29±14	1±12	-7±9	-10±4	-12±5	-9±5	-13±4	-9±5
		Snowmelt	6±7	-6±6	-14±7	-30±5	-34±5	-14±5	33±12	19±5	-17±3	-28±3	-20±5	-11±6	-5±4
		Glacier	0±0	0±0	0±0	0±0	54±18	5±7	-4±4	-5±4	2±8	39±12	0±0	0±0	5±5
	2071-2150 (SSP2-4.5)	Total	-6±4	-6±4	0±5	8±7	5±11	1±6	14±7	9±7	2±7	5±6	-2±5	-4±4	6±6
		Rainfall	-6±4	-8±3	-8±3	-7±4	13±7	87±22	25±14	18±9	13±8	12±9	12±7	-3±4	11±7
		Snowmelt	38±17	27±11	25±11	-10±7	-30±8	-19±6	20±11	8±7	-20±3	-26±4	-9±10	13±14	-8±5
		Glacier	0±0	0±0	0±0	0±0	47±29	6±8	-1±7	1±8	9±13	57±25	0±0	0±0	9±8
	2021-2050 (SSP5-8.5)	Total	-15±3	-14±3	-10±3	-6±5	-7±7	-5±6	3±7	-2±5	-10±5	-10±5	-11±4	-13±3	-5±5
		Rainfall	-35±2	-41±2	-30±2	-36±3	24±11	320±49	157±26	8±8	-27±5	-48±3	-40±3	-29±3	-9±6
		Snowmelt	9±11	-3±8	-8±6	-28±6	-31±6	-14±6	30±10	17±4	-18±2	-30±4	-20±7	-10±8	-6±4
		Glacier	0±0	0±0	0±0	0±0	55±13	7±6	-1±4	-1±6	7±9	52±12	0±0	0±0	9±6
	2071-2150 (SSP5-8.5)	Total	11±10	12±9	25±11	50±17	50±18	34±13	54±28	47±24	35±17	42±19	27±16	16±12	40±18
		Rainfall	-18±7	-26±6	-12±8	-7±10	165±40	689±122	377±108	89±36	24±19	-14±12	-20±9	-9±9	52±24
		Snowmelt	131±32	91±21	77±21	14±15	-18±11	-22±8	19±13	14±13	-23±7	-27±8	24±16	67±21	-4±7
		Glacier	0±0	0±0	0±0	0±0	187±72	72±23	45±21	48±24	78±31	0±0	0±0	0±0	78±27
NX-BXK	2021-2050 (SSP2-4.5)	Total	-17±3	-18±3	-20±5	-10±9	-15±7	-18±6	-10±6	-11±4	-16±4	-15±7	-15±4	-17±3	-14±4
		Rainfall	-16±3	-15±4	-16±5	-5±12	-16±11	-21±9	-19±7	-19±5	-23±5	-20±7	-17±4	-17±2	-19±5
		Snowmelt	-38±6	-43±4	-36±5	-27±6	-26±5	-20±4	14±8	33±7	48±7	-9±9	-27±8	-31±7	-6±4
		Glacier	0±0	0±0	0±0	0±0	77±14	-1±6	-10±5	-16±3	-14±4	4±8	0±0	0±0	-7±4
	2071-2150 (SSP2-4.5)	Total	-10±4	-9±6	-9±6	9±13	6±12	-5±8	3±11	-2±8	-4±9	1±12	-8±5	-10±4	-1±7
		Rainfall	-9±3	-8±5	-3±6	13±16	15±18	1±12	1±12	-5±10	-7±9	-5±12	-10±5	-10±4	-2±8
		Snowmelt	-24±11	-26±9	-27±7	-8±10	-15±8	-16±9	15±8	34±7	62±24	23±19	-24±9	-19±7	1±5
		Glacier	0±0	0±0	0±0	0±0	95±32	5±10	-5±10	-13±8	-12±7	21±14	0±0	0±0	-1±8
	2021-2050 (SSP5-8.5)	Total	-17±3	-18±4	-20±3	-12±5	-16±5	-18±5	-10±4	-10±3	-13±4	-13±9	-13±5	-16±3	-13±3
		Rainfall	-16±3	-15±4	-15±4	-6±6	-17±5	-23±9	-20±6	-19±5	-21±5	-18±9	-17±4	-17±3	-19±5
		Snowmelt	-38±4	-42±7	-37±4	-31±6	-26±4	-19±4	15±5	33±6	52±6	-6±12	-25±9	-32±8	-5±2

		Glacier	0±0	0±0	0±0	0±0	81±15	2±7	-7±4	-13±4	-11±5	10±7	0±0	0±0	-4±4
	2071-2150 (SSP5-8.5)	Total	2±6	6±7	21±12	51±23	45±19	21±16	24±19	24±16	22±17	34±20	11±11	3±7	25±14
		Rainfall	0±6	4±6	23±13	55±31	62±27	39±25	21±25	10±18	1±15	10±15	-1±7	-2±6	18±14
		Snowmelt	4±17	-6±8	-6±13	16±15	-2±14	-17±10	12±7	73±16	171±45	95±47	4±17	10±15	17±7
		Glacier	0±0	0±0	0±0	0±0	291±85	74±28	42±24	27±19	33±20	0±0	0±0	0±0	57±25
YZ	2021-2050 (SSP2-4.5)	Total	-16±3	-16±3	-17±3	-9±8	-14±7	-13±6	-5±6	-6±3	-13±4	-13±6	-13±4	-15±3	-10±4
		Rainfall	-16±3	-15±3	-15±3	-5±9	-9±11	-12±9	-15±7	-13±4	-18±4	-15±6	-15±3	-16±3	-14±5
		Snowmelt	-20±6	-33±4	-30±5	-28±5	-30±5	-20±4	21±8	28±6	-2±3	-26±4	-24±4	-22±5	-5±3
		Glacier	0±0	0±0	0±0	0±0	70±16	4±6	-7±4	-12±3	-9±5	13±9	0±0	0±0	-2±4
	2071-2150 (SSP2-4.5)	Total	-7±4	-8±4	-6±5	8±10	6±12	-3±7	7±8	5±7	0±8	2±9	-4±5	-7±4	2±6
		Rainfall	-8±3	-8±4	-5±4	11±12	26±18	11±12	7±9	6±9	2±9	3±9	-6±4	-8±3	4±7
		Snowmelt	3±12	-12±9	-15±7	-7±9	-21±7	-19±7	15±8	21±6	-2±6	-20±4	-15±9	-5±10	-4±4
		Glacier	0±0	0±0	0±0	0±0	74±30	8±9	-3±8	-8±8	-5±9	31±17	0±0	0±0	3±8
	2021-2050 (SSP5-8.5)	Total	-16±2	-16±2	-16±2	-10±4	-14±5	-13±5	-5±5	-5±3	-11±5	-11±6	-12±4	-14±3	-9±4
		Rainfall	-16±3	-16±3	-15±3	-6±5	-10±6	-14±9	-15±6	-12±5	-16±5	-14±7	-14±4	-16±3	-14±5
		Snowmelt	-19±5	-32±6	-29±3	-30±5	-28±4	-20±4	20±7	27±5	-2±3	-27±4	-24±6	-22±6	-6±3
		Glacier	0±0	0±0	0±0	0±0	72±14	6±6	-4±4	-9±4	-5±6	21±9	0±0	0±0	2±5
	2071-2150 (SSP5-8.5)	Total	7±8	9±8	21±9	50±19	47±18	27±14	35±21	38±21	30±17	37±18	21±14	11±9	32±15
		Rainfall	3±7	5±7	16±9	49±23	79±28	58±25	42±29	38±24	28±18	30±17	11±11	5±8	33±18
		Snowmelt	56±20	21±11	14±14	18±14	-8±12	-20±9	12±5	40±14	14±11	-13±11	12±14	36±17	5±6
		Glacier	0±0	0±0	0±0	0±0	250±81	80±26	44±22	34±21	46±23	0±0	0±0	0±0	65±26

Table 3. Projected changes (%) in mean annual and seasonal precipitation in 2021–2050 and 2071–2100, respectively, relative to 1971–2000 under the two SSPs in the YZ basin and its two sub-basins. The uncertainties are indicated with one standard deviation.

Basin	Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
NX	2021-2050 (SSP2-4.5)	-1.5±5.7	0.1±7.3	-4.1±4.7	6.9±7.8	18.4±10	10.5±8.5	11.4±3.8	1.2±4.0	3.7±5.4	6.6±5.43	-10.8±9	-11.8±13	6.50±3.3
	2071-2100 (SSP2-4.5)	-0.1±9	1.8±7.6	-2.9±5.9	14.2±14	25.4±10	15.4±8.5	18.1±4.9	9.0±4.80	11.9±5.2	14.8±8.9	-12.6±9	-12.3±13	12.8±3.8
	2021-2050 (SSP5-8.5)	-0.5±7.6	1.2±4.7	1.02±7.1	10.9±9.4	20.2±9	8.7±10.1	10.1±4.8	2.7±4.6	2.8±5.2	3.2±8.3	-13.6±8	-14.5±9	6.42±3.7
	2071-2100 (SSP5-8.5)	3.69±10	6.41±7.7	5.95±8.8	29.9±18	49.2±13	34.9±14	36.5±18	24±11.3	22.3±7.9	40.8±14	3.5±12.4	-9.5±10	29.4±9.6
NX-BXK	2021-2050 (SSP2-4.5)	-1.1±11	-3.4±5.1	-3.6±8.4	2.5±11.8	9.7±9.9	-0.2±5.8	1.94±7.8	-3.4±4.5	-9.5±6.1	-7.2±9.7	-15.4±12	-11±9.9	-1.9±3.8
	2071-2100 (SSP2-4.5)	2.8±11.6	-1.1±8.4	1.04±9.2	12.2±14	22.9±14	4.74±6.6	11.5±11	-0.1±8.6	-2.7±9.9	-1.6±13	-14.2±11	-10±11	4.55±5.1
	2021-2050 (SSP5-8.5)	-3.1±7.8	-4.4±7.3	-1.6±5.2	-0.1±6.9	9.91±5.9	-2.7±6.9	0.68±6.7	-3.3±6.1	-7.5±5.8	-7.9±13	-15.5±9	-16±9.3	-2.6±3.3
	2071-2100 (SSP5-8.5)	9±13	4.13±6.3	15.3±16	32.8±21	41.4±18	17.5±14	22.2±20	8.8±16.8	-1.6±10	11.9±15	-1.8±13	-7.8±18	15.6±8.7
YZ	2021-2050 (SSP2-4.5)	-1.3±8.7	-2.2±5.7	-3.8±6.5	4.19±9.9	14±9.8	6±7	8.2±4.9	-0.1±3.7	-1.8±4.7	-1.1±7	-13±10	-11.3±10	2.76±3.3

	2071-2100 (SSP2-4.5)	1.7±10.3	-0.1±7.6	-0.2±7.4	13±14	24.1±11	11±6.23	15.9±6	6.3±5.68	5.7±6.37	5.5±10.8	-13.5±10	-10±11	9.2±4.28
	2021-2050 (SSP5-8.5)	-2.1±7.2	-2.5±5.5	-0.8±5.6	4±7	15±6.3	4±8.2	6.9±4.84	1±4.5	-1.5±4.8	-3±10.2	-14±7.7	-15±8.4	2.4±3.2
	2071-2100 (SSP5-8.5)	7±11.9	4.9±5.9	12.4±13	31.7±19	45.3±14	27.7±13	31.6±18	20.2±11	12.2±8.1	24.6±14	0.3±12.9	-8±14.8	23.3±8.7

Table 4. Projected changes (℃) in mean annual and seasonal temperature in 2021–2050 and 2071–2100, respectively, relative to 1971–2000 under the two SSPs in the YZ basin and its two sub-basins. The uncertainties are indicated with one standard deviation.

Basin	Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
NX	2021-2050 (SSP2-4.5)	1.43± 0.35	1.04± 0.535	1.139± 0.527	1.428± 0.607	1.231± 0.524	1.023± 0.348	0.835± 0.209	0.939± 0.26	1.027± 0.383	0.838± 0.184	1.372± 0.507	1.657± 0.597	1.163± 0.279
	2071-2100 (SSP2-4.5)	3.192± 0.935	2.952± 0.651	2.93± 0.51	3.226± 0.678	2.95± 0.795	2.541± 0.42	2.412± 0.468	2.459± 0.46	2.58± 0.606	2.55± 0.508	3.508± 1.097	3.787± 0.9	2.924± 0.472
	2021-2050 (SSP5-8.5)	1.599± 0.29	1.34± 0.543	1.341± 0.335	1.42± 0.378	1.178± 0.422	1.111± 0.336	1.061± 0.258	1.147± 0.288	1.207± 0.395	1.256± 0.196	1.821± 0.728	1.953± 0.443	1.369± 0.222
	2071-2100 (SSP5-8.5)	6.227± 0.778	5.826± 0.634	5.72± 0.805	5.982± 1.252	5.435± 1.095	4.735± 0.838	4.535± 1.064	4.721± 1.158	5.05± 1.05	5.558± 1.224	6.679± 1.684	6.916± 1.489	5.615± 0.853
NX-BXK	2021-2050 (SSP2-4.5)	0.88± 0.454	0.56± 0.475	0.274± 0.396	0.537± 0.349	0.427± 0.207	0.32± 0.326	0.465± 0.326	0.543± 0.311	0.671± 0.323	0.327± 0.303	0.708± 0.334	1.204± 0.534	0.576± 0.246
	2071-2100 (SSP2-4.5)	2.55± 0.974	2.291± 0.655	1.88± 0.588	2.245± 0.557	2.083± 0.458	1.895± 0.66	2.036± 0.763	2.027± 0.58	2.162± 0.553	1.923± 0.601	2.64± 0.749	3.152± 0.979	2.24± 0.51
	2021-2050 (SSP5-8.5)	1.108± 0.168	0.791± 0.45	0.446± 0.268	0.505± 0.295	0.515± 0.294	0.508± 0.404	0.721± 0.293	0.783± 0.317	0.839± 0.32	0.712± 0.22	1.181± 0.4	1.54± 0.296	0.804± 0.164
	2071-2100 (SSP5-8.5)	5.406± 0.841	4.852± 0.654	4.365± 0.785	4.656± 1.02	4.269± 0.82	3.823± 1.033	4.008± 1.191	4.246± 1.349	4.551± 1.048	4.719± 1.299	5.692± 1.329	6.303± 1.409	4.741± 0.902

YZ	2021-2050 (SSP2-4.5)	1.319± 0.358	0.942± 0.511	0.963± 0.488	1.246± 0.541	1.069± 0.441	0.88± 0.332	0.761± 0.214	0.858± 0.258	0.954± 0.37	0.735± 0.191	1.236± 0.437	1.564± 0.576	1.044± 0.259
	2071-2100 (SSP2-4.5)	3.064± 0.933	2.818± 0.641	2.716± 0.519	3.026± 0.636	2.774± 0.688	2.409± 0.433	2.335± 0.506	2.37± 0.477	2.495± 0.594	2.424± 0.512	3.331± 0.991	3.658± 0.896	2.785± 0.465
	2021-2050 (SSP5-8.5)	1.501± 0.234	1.229± 0.512	1.159± 0.311	1.233± 0.348	1.043± 0.367	0.989± 0.344	0.992± 0.249	1.072± 0.278	1.132± 0.378	1.146± 0.192	1.69± 0.642	1.869± 0.396	1.254± 0.198
	2071-2100 (SSP5-8.5)	6.061± 0.768	5.628± 0.619	5.444± 0.793	5.712± 1.188	5.198± 0.955	4.55± 0.864	4.428± 1.088	4.624± 1.195	4.948± 1.048	5.388± 1.228	6.477± 1.537	6.79± 1.427	5.437± 0.846