Drought Characteristics of Lancang-Mekong River Basin and the Impacts of Reservoir Regulation on Streamflow

July 2020

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Contents

Executive Summary

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Chapter 1 Introduction

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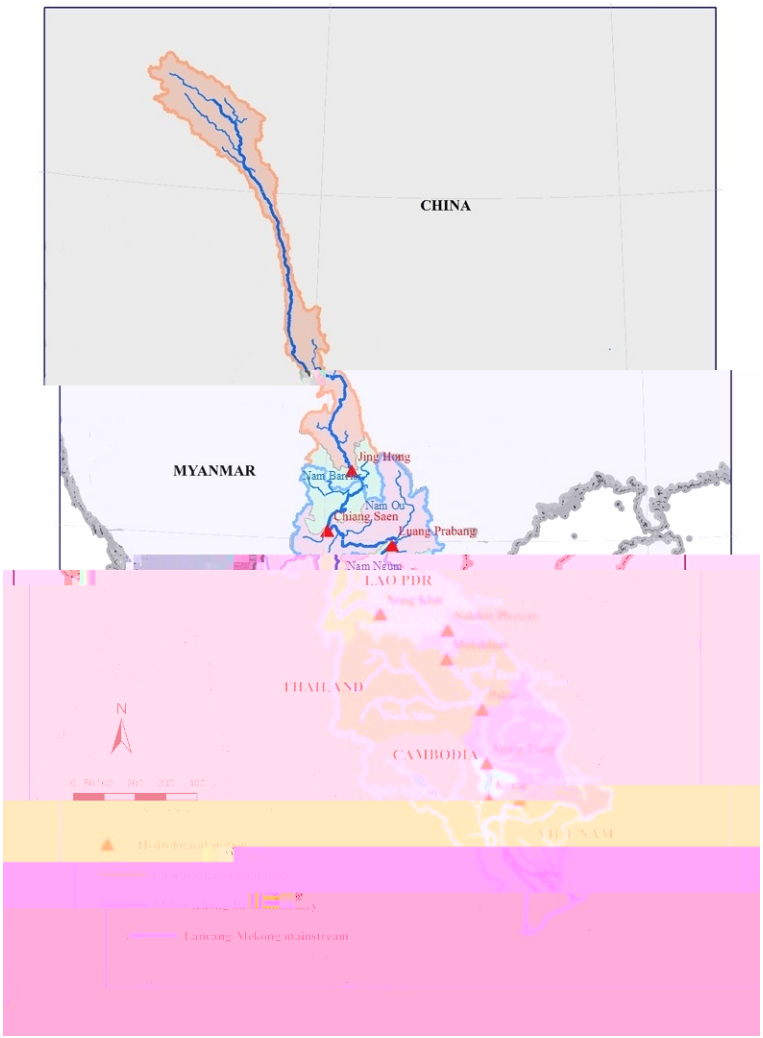

Fig re 1. Ri er ne ork and main h drological a ion along he main ream of he Lancang-Mekong Ri er

Table 1. Charac eri ic of main h drological a ion along he main ream of Lancang-Mekong Ri er

Ri e	**S a i**	**C**	**D ai age a ea (10^4 ^{2})**	**Di a ce he e a ( )**
Lancang	Jinghong	China	14.91	2718
Mekong	Chiang Saen	Thailand	18.90	2364
	L ang Prabang	Lao PDR	26.80	2010
	Nong Khai	Thailand	30.20	1580
	Nakhon Phanom	Thailand	37.30	1221
	M kdahan	Thailand	39.10	1128
	Pak e	Lao PDR	54.50	867
	S ng Treng	Cambodia	63.50	683

Chapter 2 Data and Methods

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Table 2. Parame er and con r c ion ear of major dam on he Lancang Ri er (WLE, 2018)

P jec a e	**C e cia O e a i Da e**	**Dead age (MCM)**	**T a age (MCM)**
Man an	1992	630	887
Dachao han	2003	465	740
Jinghong	2009	810	1119
Xiao an	2010	4750	14645
Gongg oqiao	2012	196	316
N o had	2014	10414	21749
Miao ei	2016	359	660
H angdeng	2017	1031	1418
W nonglong	2018	236	272
Dah aqiao	2018	252	293
Lidi	2019	57	71

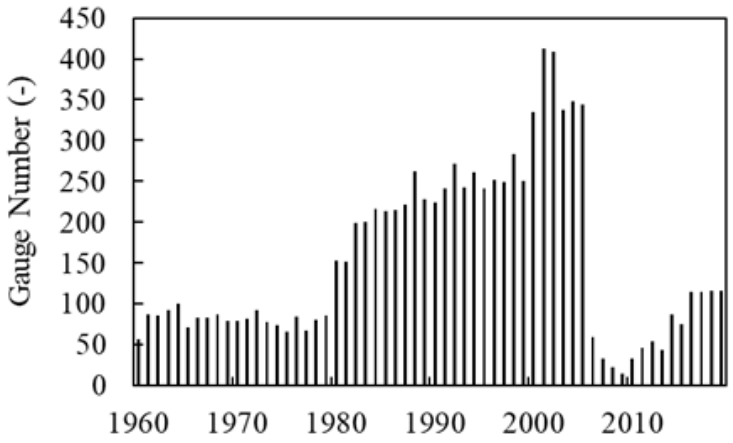

Fig re 2. N mber of a ailable rain ga ge from 1960 o 2019 in he Mekong Ri er Ba in

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$$\mathrm{SPI} = \mathrm{S}\left\{t - \frac{(c_2 t + c_1)t + c_0}{[(d_3 t + d_2)t + d_1]t + 1.0}\right\} \quad (1)$$

$$\mathrm{t} = \sqrt{ln\frac{1}{2}} \quad (2)$$

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$$\mathrm{G}(x) = \frac{2}{\gamma\ 0}\int_0 x\ \ ^1e\ \ /\ dx, \quad x > 0 \quad (3)$$

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Table 3. Grade of SPEI/SPI

G ade	**T e**	**SPEI/SPI**	
Chi a	**Chi a / WMO**	**WMO**	**Chi a**
I	No dro gh	>0.0	>-0.5
II	Mild dro gh	(-1.0, 0.0)	(-1.0, -0.5)
III	Modera e dro gh	(-1.5, -1.0)	(-1.5, -1.0)
IV	Se ere dro gh	(-2.0, -1.5)	(-2.0, -1.5)
V	E cep ional dro gh	-2.0	-2.0

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$$NSE = 1 - \frac{\Sigma^{N} \quad (Q_o^n - Q_s^n)^2}$$

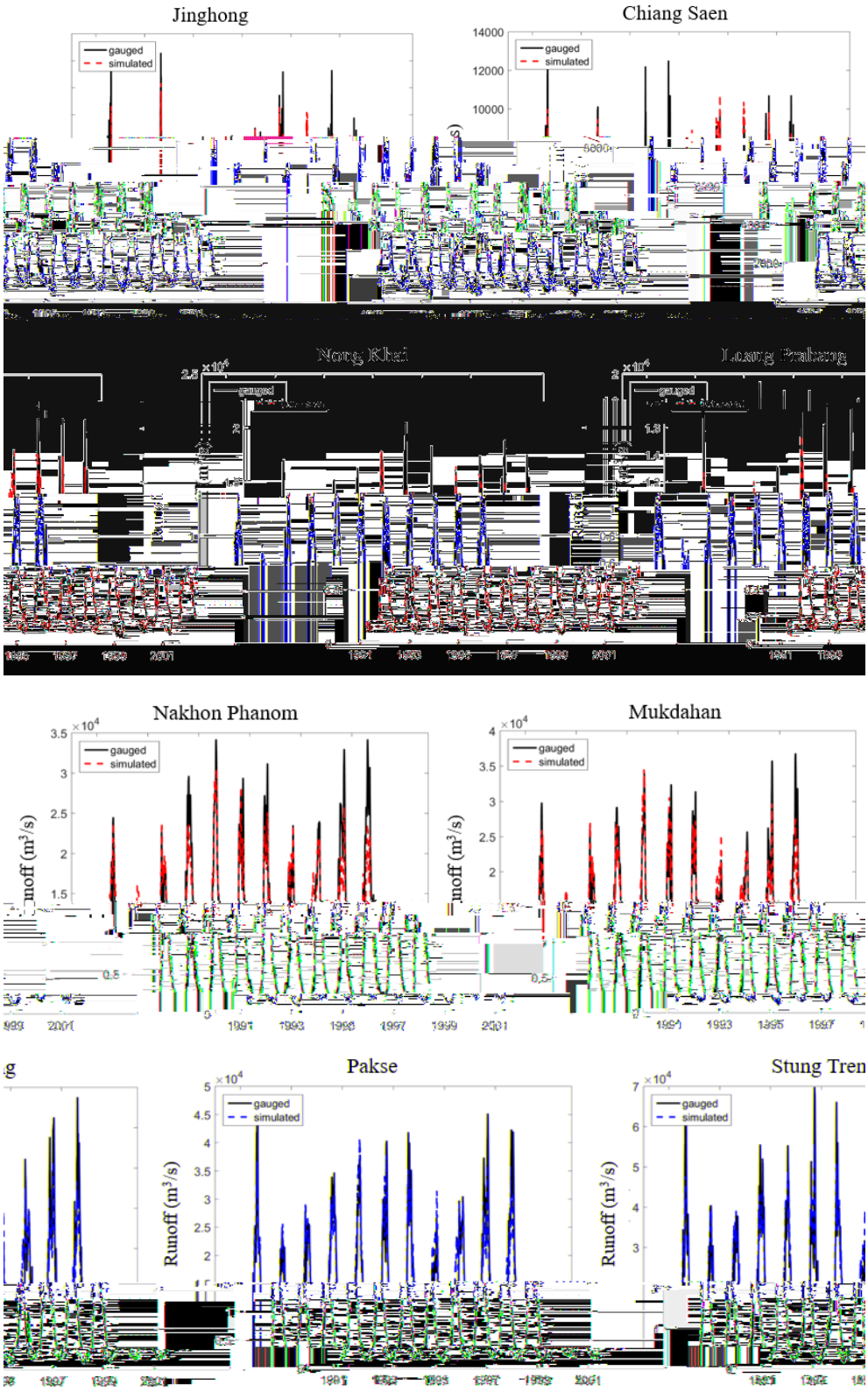

Fig re 3. Sim la ed and ob er ed dail reamflo a he 8 a ion along he main ream of he Lancang-Mekong Ri er

Table 4. E al a ion me ric of THREW model im la ion in he LMRB

H d gica Ga ge	**D i e b ga ge ai fa da a**					**D i e b IMERG ai fa da a**
	Ca ib a i (1991-1996)		**Va ida i (1997-2001)**			**(2001-2005) NSE**
Jinghong	0.86	0.78	0.89	0.85	-3.22%	0.89
Chiang Saen	0.88	0.85	0.9	0.92	1.31%	0.95
L ang Prabang	0.88	0.89	0.92	0.94	3.21%	0.94
Nong Khai	0.92	0.93	0.92	0.95	3.23%	0.95
Nakhon Phanom	0.92	0.92	0.89	0.94	-3.57%	0.9
M kdahan	0.94	0.93	0.93	0.95	4.92%	0.89
Pak e	0.94	0.95	0.91	0.95	0.72%	0.87
S ng Treng	0.92	0.92	0.89	0.93	2.60%	0.87
A erage	0.91	0.9	0.91	0.93	-	0.91

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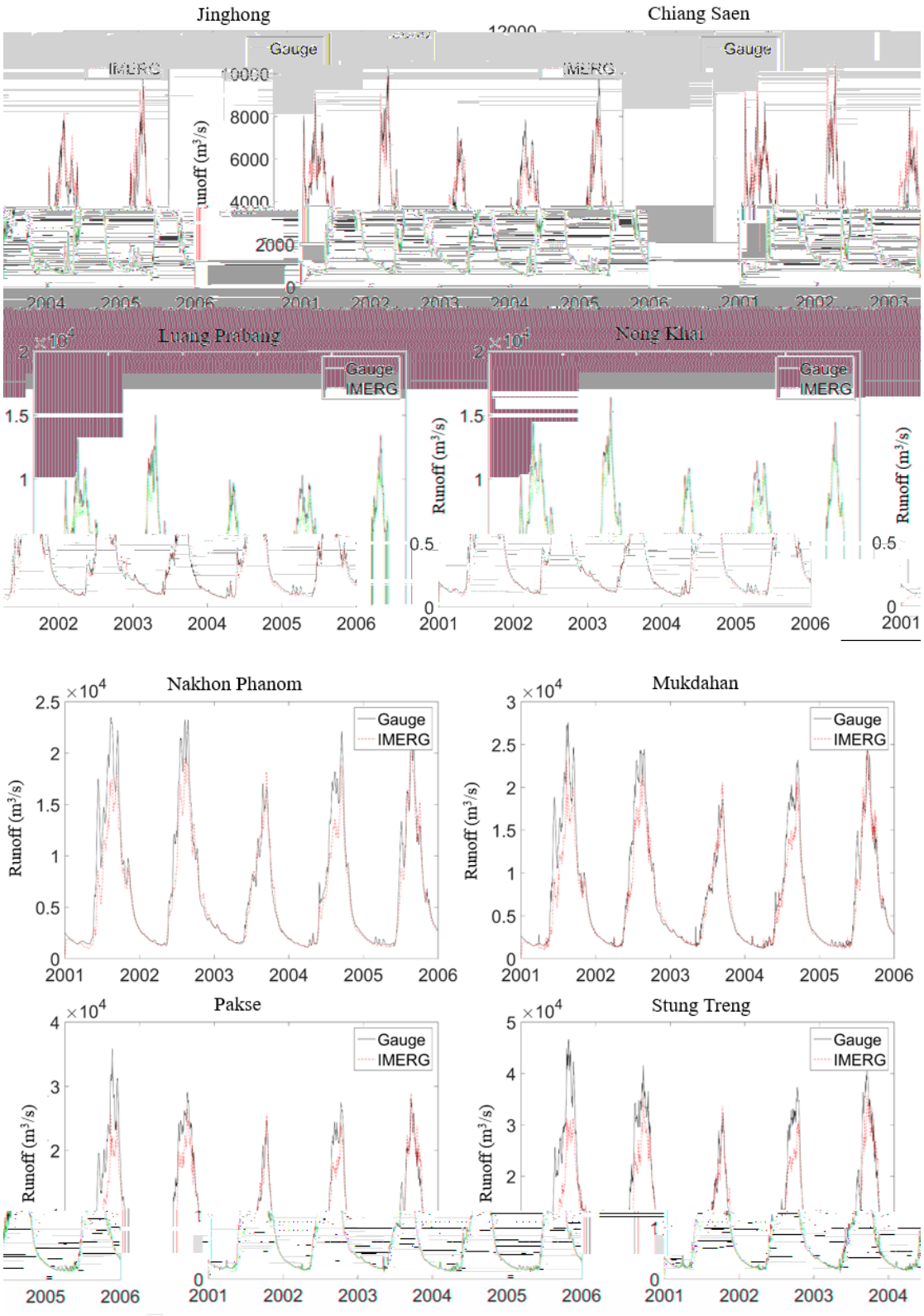

Fig re 4. S reamflo im la ion dri en b he a elli e rainfall and he ga ge rainfall a 8 h drological a ion along he main ream of Lancang-Mekong Ri er

Chapter 3 Results

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Table 5. Share of dro gh occ rred in dr ea on and e ea on

D gh e	Sea	SPEI3	SPI3
Mild and abo e (SPEI/SPI<-0.5)	Dr	54%	58%
	We	46%	42%
Modera e and abo e (SPEI/SPI<-1)	Dr	62%	64%
	We	38%	36%

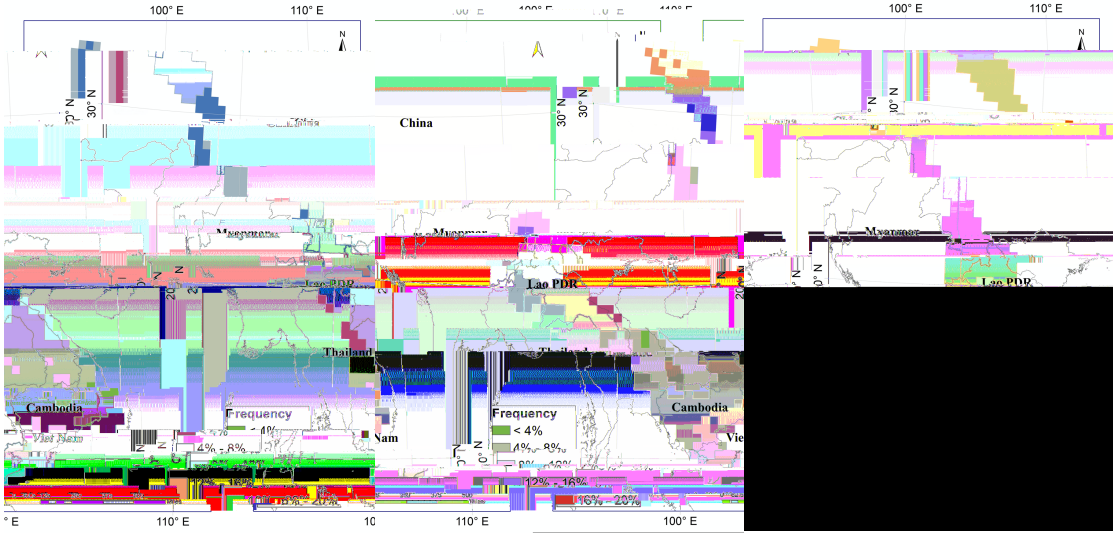

Fig re 5. Freq enc of e ere and e cep ional dro gh in LMRB ba ed on SPEI12

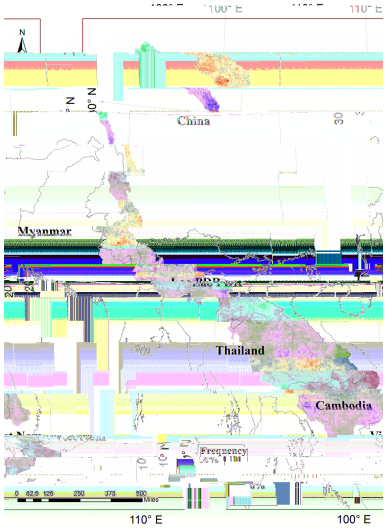

Fig re 6. Freq enc of e ere and e cep ional dro gh in LMRB ba ed on SPI12 (1981-2019)

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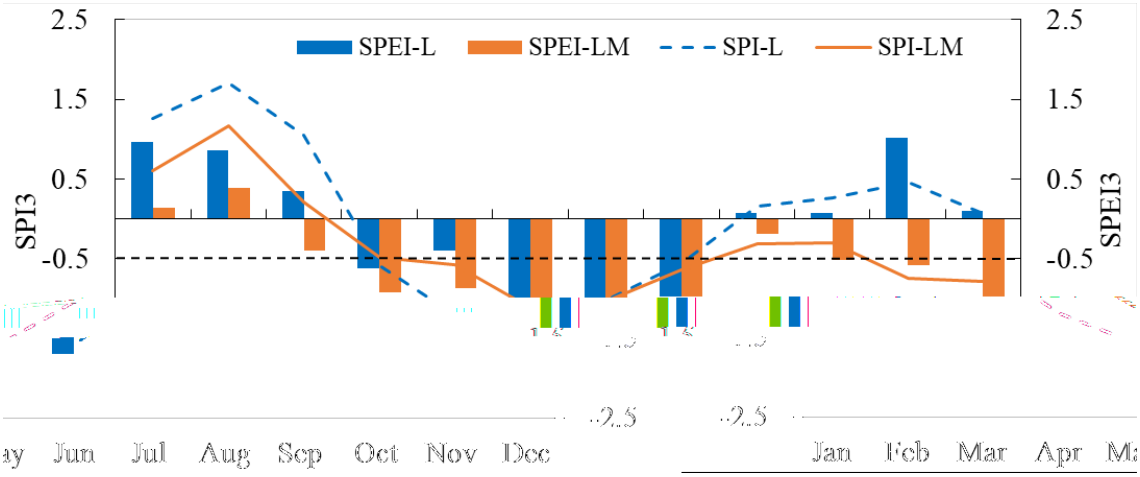
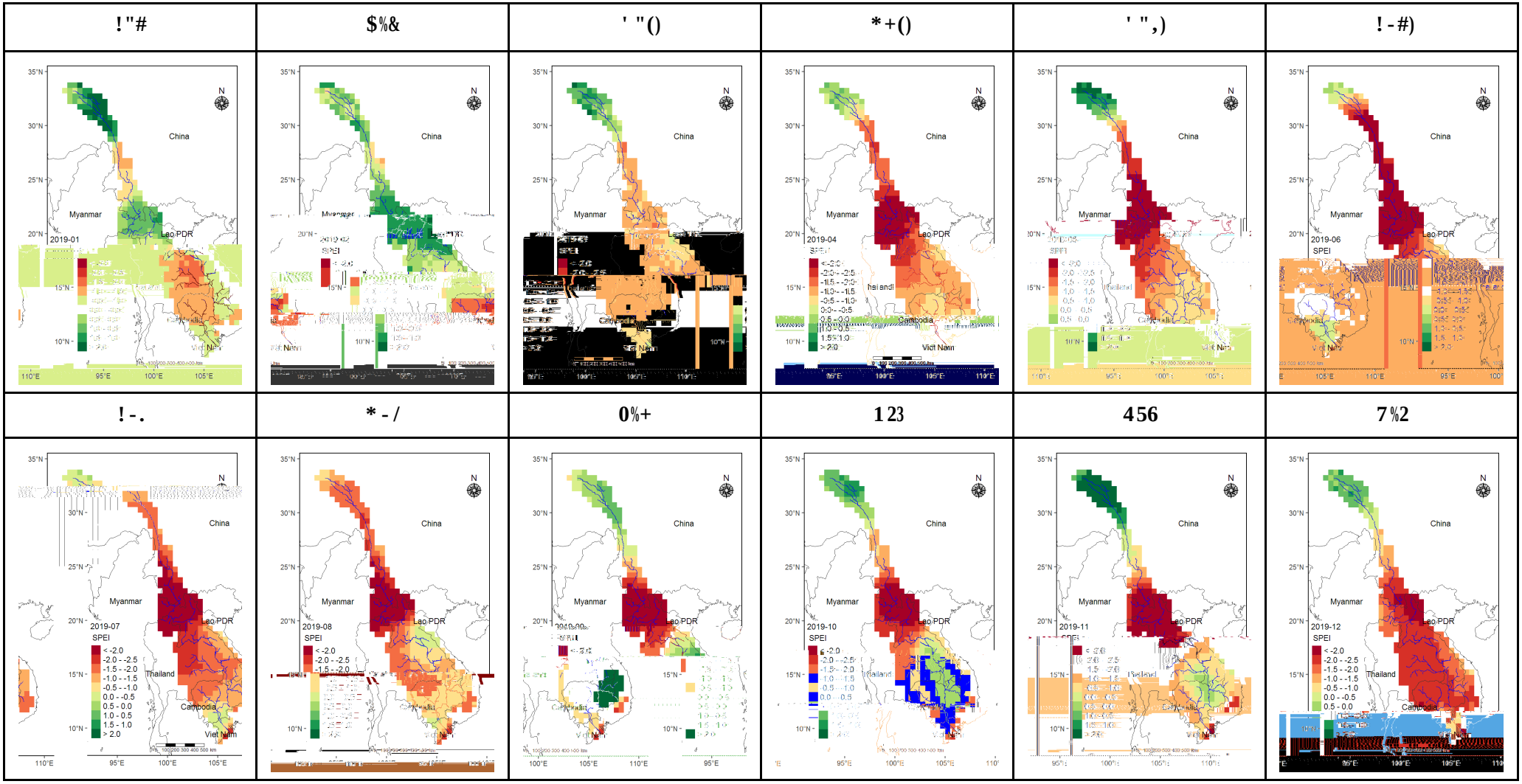


Fig re 8. Dro gh inde eq ence of 2019 (L i Lancang Ri er Ba in; LM i LMRB)



F 9. M SPEI3 LMRB 2019 (CRU TS).

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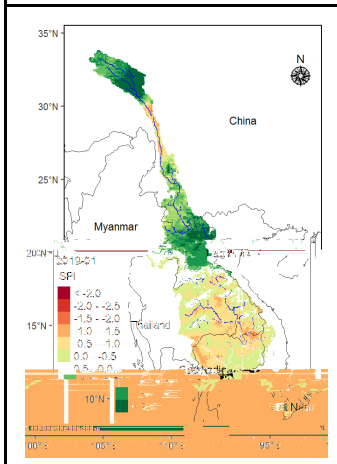	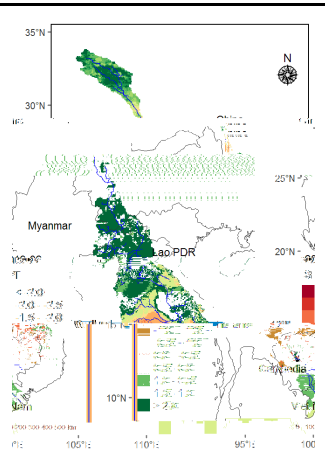	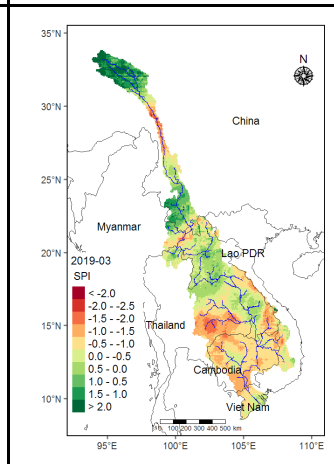	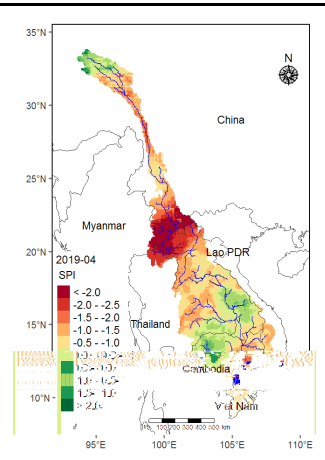	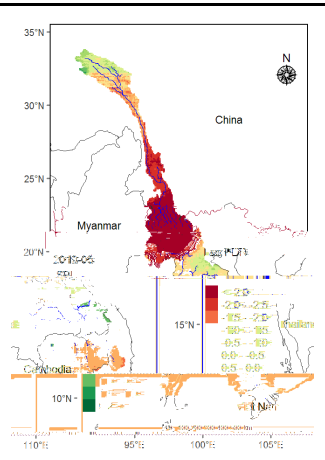	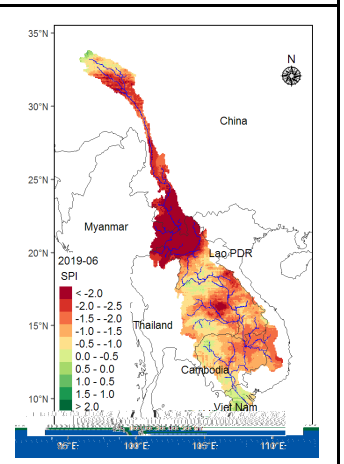
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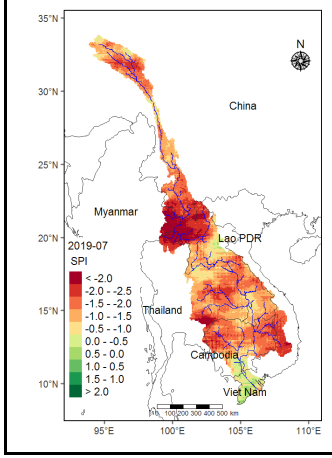	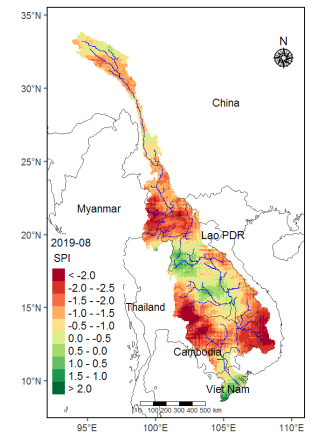	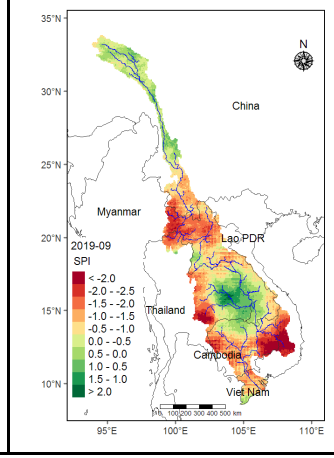	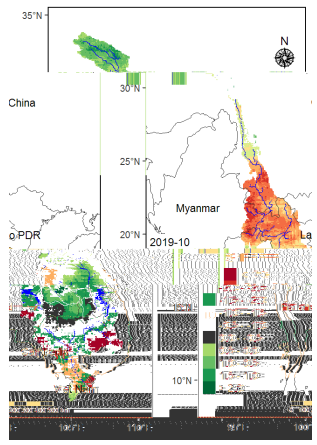	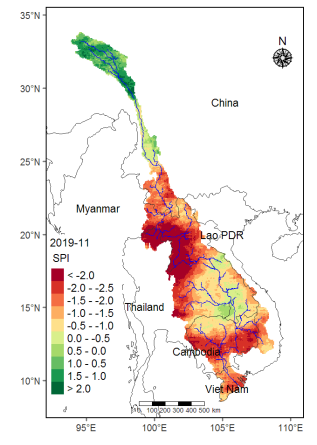	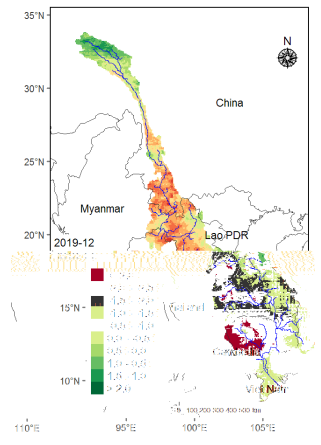

F 10. M SPI3 LMRB 2019 (CHIRPS).

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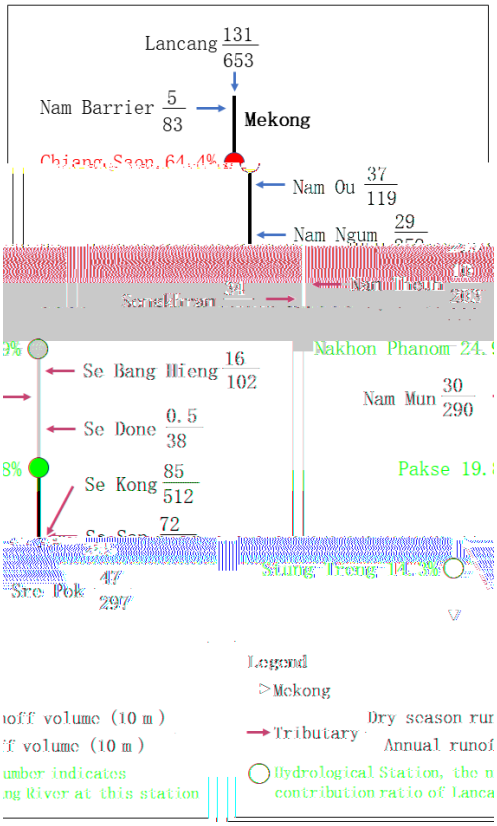

F 11. R a b a a d c b a La ca R

Tab 6. C b a (%) a b a a a a d ca a a M R (1991-2019)

C **a** **La a** **Na Ba** **Na O** **Na N** **Na T** **S Na a** **S Ba H** **S D** **Na M** **S Sa** **S K** **S P** **H a a**

* Runoff from Lancang Ri er means the discharge at Jinghong Station

3.4 Impacts of reservoir regulation on mainstream discharge

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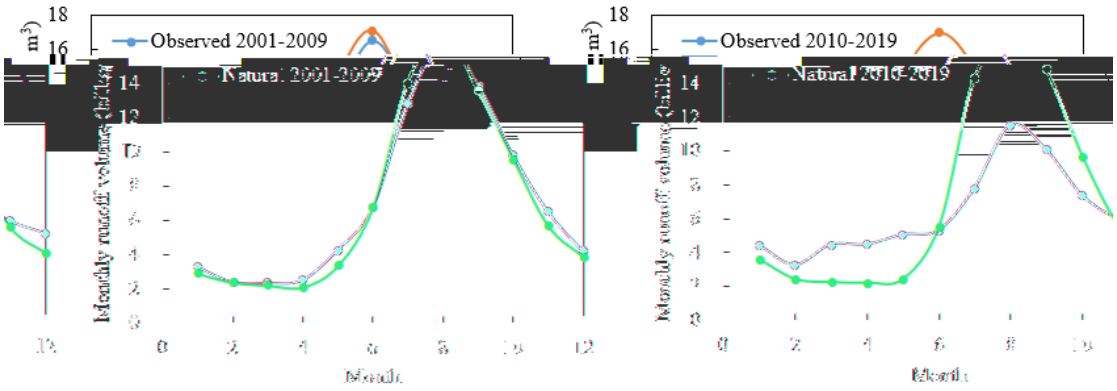

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Chapter 4 Conclusions and Recommendations

4.1 Main findings

4.2 Recommendations

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Ackno ledgements

References

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