To Reviewer #1:

General Comments:

It has been a pleasure reading through this contributions. This work characterizes the drought by linking climate anomaly with the change in precipitation-runoff relationship in China's Loess Plateau, and discusses the policy implications of the study to water resource management in a water-limiting environment. The study is scientifically valid, the methods and data sources are well explained, and the results are clear and well presented, though there are some aspects need to ameliorate. Overall, I would recommend this manuscript for publication in Hydrology and Earth System Sciences, with some comments and suggestions.

[Response] We thank the reviewer for supporting the publication of this MS. The MS will be revised carefully after the reviewer's comments and suggestions, with the detailed responses as followed.

[Reviewer #1 Comment 1] *Section 2.4.1. Parameters estimation: The paper chooses seven commonly functions as the candidate margins distribution for drought duration and severity, there are some deficiencies in fitting margin distribution function. For example, "by comparison…", I hope the authors can provide quantitative value to determine distribution functions. "drought and severity are fitted with weibull and gamma …", the authors need to show relevant statistical indicators.*

[Response] According to the comment, we will provide quantitative value to determine the marginal distribution function. We will use Root Mean Square Error (RMSE) and Kolmogorov-Smirnov (K-S) test to select the best fitted distribution. Table R1.1 lists the estimated parameters and the results of goodness of fit test. We can find that not all the distributions pass the K-S test at the 95% (α=0.05) significant level. Further considering RMSE, the best fitted marginal distributions of duration, severity are weibull and gamma, respectively, which are marked with bold fonts and underlined in Table1 R1.1.

Table R1.1 Parameters and goodness of fit of the marginal distributions

Distribution		Parameters	RMSE	K-S test	
				Statistic	*p*_value
(Duration)	Exponential(exp)	param_exp =3.714	0.617	0.223	0.306
	Gamma(gam)	param_gam1=1.421 param_gam2=2.614	0.625	1	0
	Log-normal(lno)	param_lno1=3.714 param_lno2=3.253	0.668	1	0
	Extreme value(ev)	param_ev1=5.319 param_ev2=3.089	0.498	1	0
	Generalized extreme value(gev)	param_gev1=3.722 param_gev2=0.008 param_gev3=1.002	0.668	1	0
	Poisson(poission)	param_poission =3.714	0.645	1	0
	Weibull(wbl)	**param_wbl1=3.975** **param_wbl2=1.213**	**0.581**	**0.248**	**0.231**
(Severity)	Exponential(exp)	param_exp =0.309	0.112	0.280	0.883
	Gamma(gam)	**param_gam1=3.690** **param_gam2=0.084**	**0.090**	**0.267**	**0.892**
	Log-normal(lno)	param_lno1=0.310 param_lno2=0.254	0.237	0.423	0.423
	Extreme value(ev)	param_ev1=0.393 param_ev2=0.168	0.127	0.280	0.883
	Generalized extreme value(gev)	param_gev1=0.111 param_gev2=0.119 param_gev3=0.227	0.092	0.276	0.885
	Poisson(poission)	param_poission =0.310	0.329	0.714	0.028
	Weibull(wbl)	param_wbl1=0.351 param_wbl2=2.071	0.098	0.286	0.822

[Reviewer #1 Comment 2] *Section 2.4.2. Only the method of Squared Euclidean Distance(SED) is used to perform the goodness-of-fit of joint distribution function, I recommend the authors can adopt more methods to evaluate the fitted copula, such as root mean square error(RMSE), the Akaike information criterion(AIC)…*

[Response] We thank the reviewer for this comment. Besides the method of Squared Euclidean Distance (SED), we will adopt root mean square error (RMSE) and the Akaike information criterion (AIC) to further evaluate the fitted copula. As shown in Table R1.2, Frank-copula is the optimal joint distribution function in most watersheds of this study except for Jialu, Dali and Beiluo watersheds. The optimal goodness of fit

of different methods are also marked with bold fonts and underlined.

Table R1.2 The goodness-of-fit about copula function

ID	Normal			t-Copula			Clayton			Frank			Gumbel		
	d^2	AIC	RMSE	d^2	AIC	RMSE	d^2	AIC	RMSE	d^2	AIC	RMSE	d^2	AIC	RMSE
1	0.277	1.481	0.233	0.272	1.088	0.224	0.259	1.251	0.228	**0.249**	**1.044**	**0.223**	0.250	1.585	0.235
2	0.118	-3.912	0.154	0.119	-3.294	0.143	**0.103**	-2.961	0.154	**0.103**	**-3.928**	**0.143**	0.105	-3.753	0.145
3	0.138	-1.868	0.166	0.140	-1.819	0.167	0.217	0.836	0.208	**0.127**	**-2.403**	**0.159**	0.131	-2.220	0.162
4	0.227	1.103	0.213	0.223	0.997	0.211	0.303	2.828	0.246	**0.220**	**0.912**	**0.210**	0.224	1.022	0.211
5	0.132	-2.129	0.169	0.132	-2.112	0.163	0.147	-1.590	0.171	**0.127**	-1.936	0.162	0.137	**-2.328**	**0.159**
6	0.378	5.186	0.275	0.374	5.116	0.274	**0.336**	4.525	0.259	0.344	**4.436**	**0.262**	0.462	6.062	0.304
7	0.188	-0.360	0.194	0.189	-0.335	0.194	0.257	1.197	0.227	**0.172**	**-0.108**	**0.186**	0.198	-0.800	0.199
8	0.199	0.685	**0.199**	0.217	1.291	0.208	0.219	1.355	0.209	**0.198**	**0.661**	**0.199**	0.206	0.936	0.202
9	0.247	2.802	0.222	0.248	2.845	0.223	0.238	2.503	0.218	**0.226**	2.417	0.217	0.235	**2.117**	**0.213**
10	0.314	5.580	0.259	0.336	6.180	0.249	0.367	6.974	0.271	**0.309**	**5.438**	**0.251**	0.323	5.834	0.254
11	0.178	-0.619	0.179	0.175	-1.15	0.189	0.174	-0.711	0.187	**0.160**	**-1.182**	**0.176**	0.159	-0.735	0.187
12	0.377	5.164	**0.274**	0.375	5.140	0.275	0.434	6.156	0.295	**0.373**	**5.089**	**0.274**	0.383	5.278	0.277
13	0.545	10.541	0.330	0.538	10.419	0.328	0.557	10.727	0.334	**0.527**	**10.229**	**0.325**	0.605	11.480	0.348
All	0.204	4.974	0.265	0.197	5.642	0.288	0.214	5.113	0.301	**0.189**	**4.312**	**0.249**	0.190	5.230	0.254

[Reviewer #1 Comment 3]*The English expression in this MS is sub-standard; it needs to be improved. The authors should further review the whole paper, although I have pointed some in specific suggestions. In addition, some sentences in the paper are very long, without clear phrasing, so that the reader is sometimes left wondering what the main point of the sentence was. The authors need also notice these problems.*

[Response] We will ask a native English speaking scientist to help us with the language of the revised MS.

Specific suggestions:

[Reviewer #1 Suggestion 1] *Page1.L4, not all readers will know that this re-vegetation is anthropogenic, you need to explicitly state this.*

[Response] Accordingly, we will explain the details of re-vegetation. China experienced serve droughts in 1997 and serious floods in 1998, causing serious economic and environmental damage (Tian et al., 2016). In the wake of these disasters, the Chinese government took unprecedented conservation measures (Xu and Cao, 2001), one of which was the Grain for Green Program (GGP) introduced in 1999 to protect the degraded environment (Zhang et al., 1999). The objective of this program was to convert cropland to plantations and grassland on steep slopes by compensating farmers with subsidies.

[Reviewer #1 Suggestion 2] *Page1.L5, delete "in the area".*

[Response] We will delete “in the area” accordingly. The sentence will be changed to “*This case study characterizes drought by linking climate anomaly with the change in precipitation-runoff relationships, in the Loess Plateau of China, a water-limited region where re-vegetation makes drought a major concern*.”

[Reviewer #1 Suggestion 3] *Page3.L11,delete "reflect".*

[Response] We will delete “reflect” accordingly. The sentence will be changed to “*So analyzing drought characteristics based on the response of the precipitation-runoff relationship (PRR) change to multi-year dry periods is of great importance in estimating the effect of drought and the ecological re-construction of the whole Loess Plateau*.”

[Reviewer #1 Suggestion 4] *Page3.L20, as the climate is changing over what years are these long-term averages calculated?*

[Response] We will clearly in the revised MS that the long-tem averages is for the period of 1960–2000.

[Reviewer #1 Suggestion 5] *Page4. L21, "propose use"?*

[Response] Accordingly, here we will modify the sentence to "we use the copula function (Shiau, 2006)."

[Reviewer #1 Suggestion 6] *Page6.L9, states that 7 dry periods are identified yet on Fig 8(a) there are 15 events. This is confusing.*

[Response] The identified 7 dry periods in Page 6 L9 are for the whole Loess Plateau. However, 15 events in Fig8(a) are for 13 watersheds. We will clarify in the revised MS as: "*Based on the drought identification method developed in this study, 7 dry periods are identified (including the main dry period and single dry period) on the whole Loess Plateau during 1961-1999. The purpose of this study is to focus on the change of the PRR in the main dry period. So further considering the variability of the PRR during dry period in each watershed (section 3.3), there are 15 dry periods (including significant changes and non-significant in the) in 13 watersheds with drought regressions fell under the total regression lines.*"

[Reviewer #1 Suggestion 7] *Page6.L19, "In1991â˘A˙ T1999(p=0.000) there was a significant decrease change significantly in the PRR", expression is repeated.*

[Response] Accordingly, we will modify the sentence to "In 1991–1999 (p=0.000) there was a significant decrease change in the PRR."

[Reviewer #1 Suggestion 8] *Page8.L6, "multi_year".*

[Response] Accordingly, we will revise "multi_yeat" to "multiyear".

[Reviewer #1 Suggestion 9] *Page8.L10, "Compared to"*

[Response] Accordingly, we will revise this sentence as "*Compared with the annual average precipitation (Table1) in other basins where significant changes occurred, these watersheds where there were no significant changes in precipitation-runoff relationship (Kuye, Dali, Qingjian, Yanhe, Jinghe) had higher precipitation.*"

[Reviewer #1 Suggestion 10] *Page10.L24, hey you are introducing a new model and a new dataset in the Discussion section. This is very non-standard the structure is all over the place.*

[Response] We agree with the reviewer that, in standard, the Net Primary Production (NPP) data that derived with terrestrial Carnegie-Ames-Stanford Approach (CASA) we used in the discussion section in Page 10 L24 should be first explained in section 2.1.

However, we will replace the NPP in this section with satellite-derived Leaf Area Index (LAI) following the comment of Reviewer #2 (See detail in the response to Reviewer #2 general comment 4). In line with this comment, we will explain the LAI data in section 2.1 in the revised MS.

[Reviewer #1 Suggestion 11] *Fig 5, Precipitation, and many other hydrological variables, have the dimensions of depth / time, and you need to include the time of integration into you units. So your X-axis should have the units of mm/year. When assessing annual trends of annual (or actual E, potential E or Epan) the units are mm/year/year, as in such a plot the X-axis is years, and the Y-axis of an annual P time-series is mm/year, so the slope (or trend) of delta_Y / delta_X has the units of mm/year/year.*

[Response] Accordingly, we will revise the X-axis, Y-axis to P (mm/year) and Runoff (mm/year) respectively in revised MS as Figure R1.1.

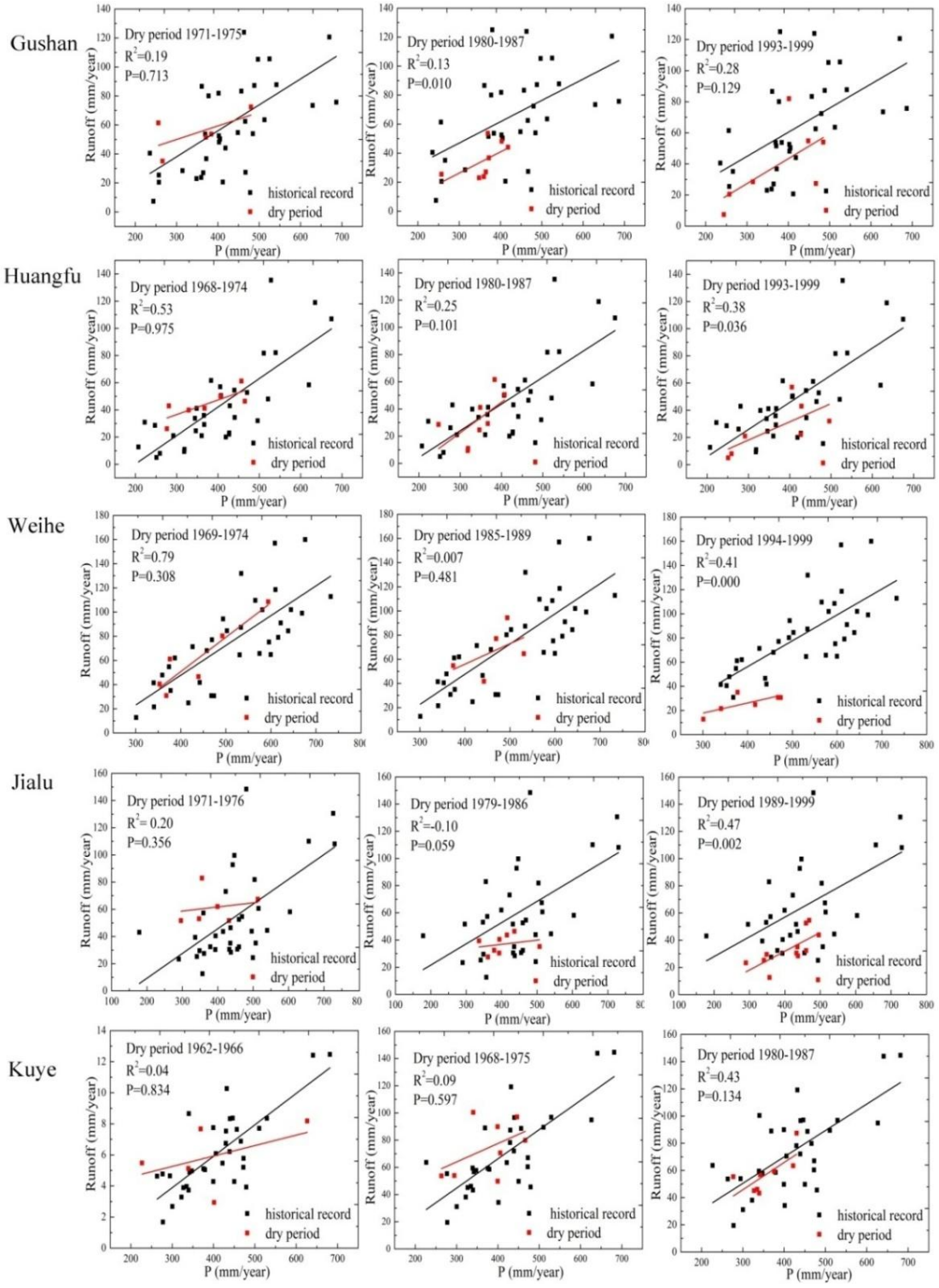

Figure R1.1. The annual precipitation-runoff scatter plot in each watershed.

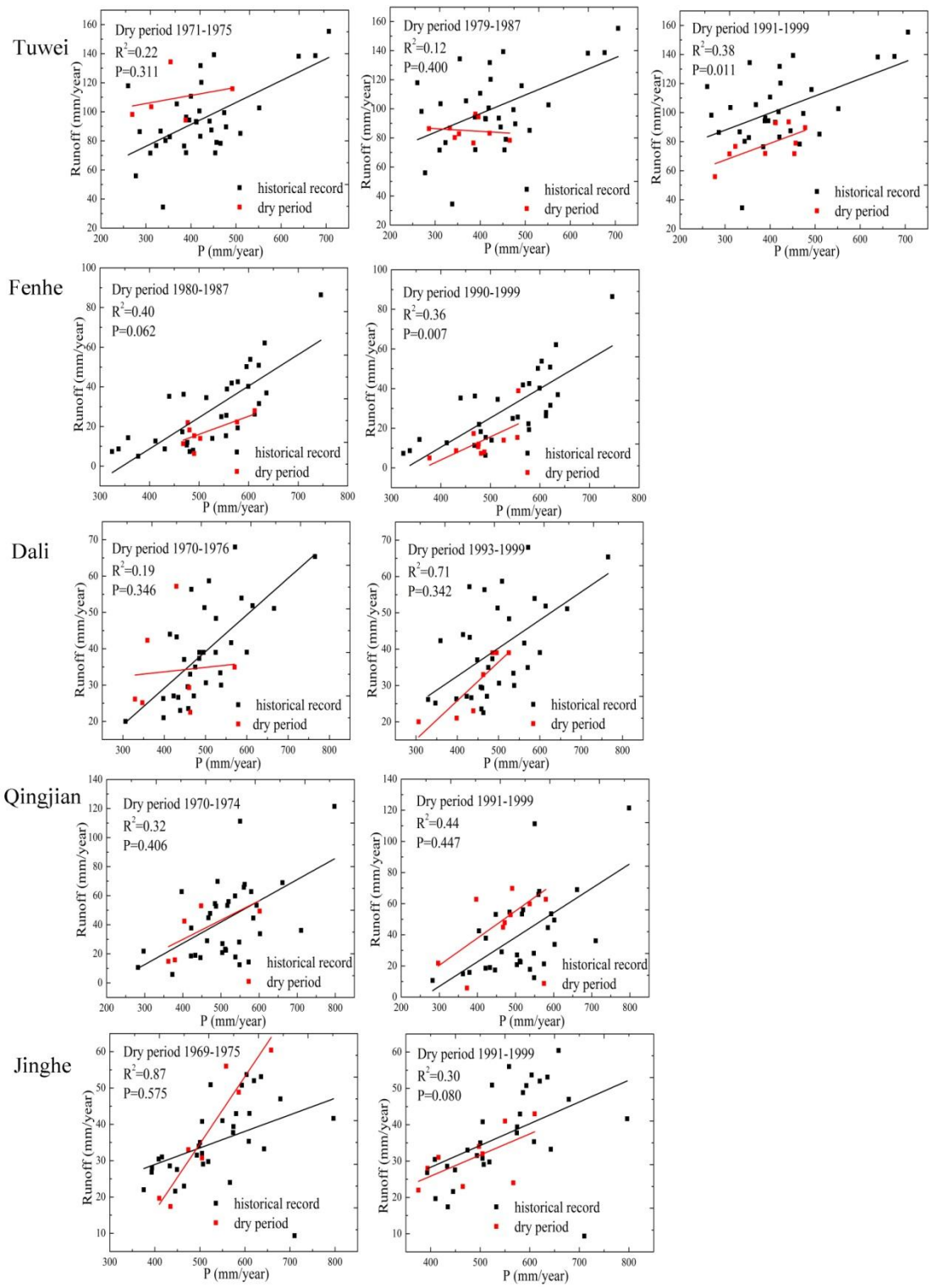

Figure R1.1. (continued).

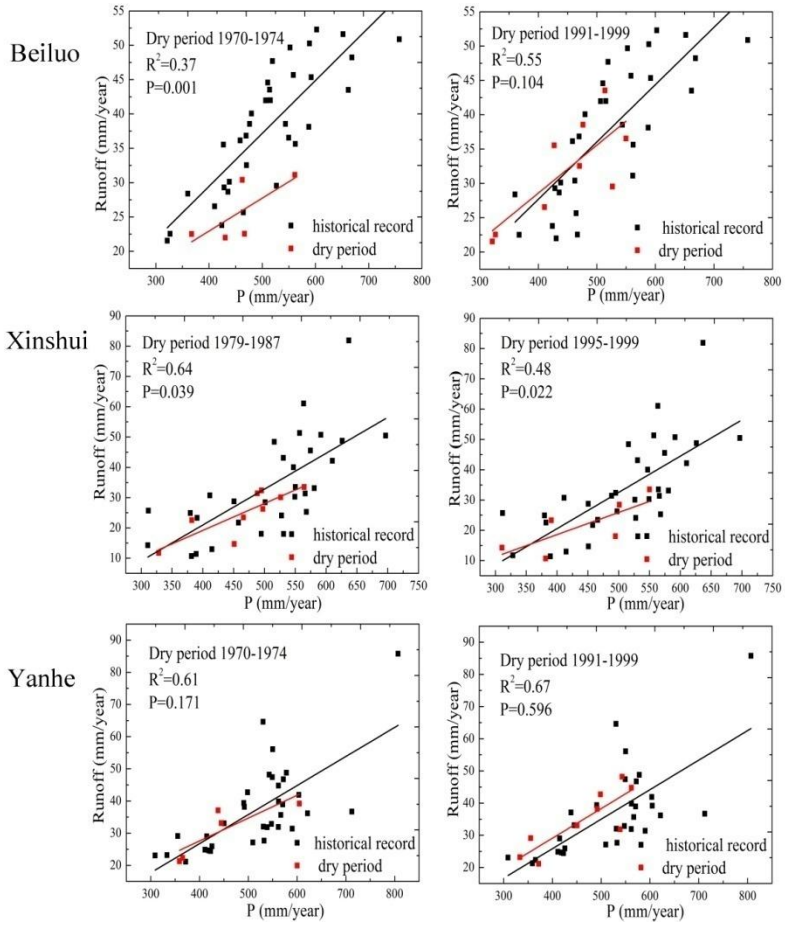

Figure R1.1. (continued).

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