Dear Anonymous Referee,

Firstly, we would say thank you very much for your constructive comments and questions on the methodology we used in this manuscript. And also we highly appreciate your valuable advices to improve the quality of our manuscript. In the following pages are point-by-point responses to each of your comments and questions.

**Fig. 3: left panels: what are the columns in GRAY? Since the time along the x-axis is not continuous, it'd better not linking the data points between neighboring period with lines (i.e. precipitation and runoff curves).**

The columns in gray are the annual precipitation and runoff in Jiulong River Watershed during 1961-2013. The 53-year annual data was divided into five periods. Each period consist of ten year data, except in the period of 2000s which has 13 data. As the time along the x-axis is continuous, we draw the line to connect data points between neighboring periods. The space between periods was made to distinguish the trend of hydro-climatic variables observed in each period.

**p6313, L10: what is the number "0.430"?**

The number of 0.403 is the statistic *p*-value of *b* (i.e. annual runoff trend) in the West River. This value explained that the annual runoff trend is insignificant in West River since the *p*-value is higher than the significance level (5%).

**p6314, L2-L6: I cannot see the linkage between evaporation and runoff response to precipitation neither from Fig. 3 nor from equation 15. Authors need further explain this claim. Actually, lower "a" and lower "b" means lower runoff and higher ET according to this equation. p 6314: L18-19: I think the opposite is right: i.e. higher "a" and "b" indicate decreasing ET.**

Fig.3 and equation 15 emphasized the runoff have a positive linear relation with precipitation and a negative exponential relation with aridity index.

$$R = P^{a} e^{-b\alpha} \qquad (15)$$

Aridity index (α) known as a dryness index refers to the ratio between potential evapotranspiration to precipitation (equation 5). Lower α means lower ET, and vice versa.

$$\alpha = \frac{E_O}{P} \qquad (5)$$

In equation 15, we defined *b* as the aridity coefficient and it is bound to *α*. Lower b will make α lower too (i.e. decreasing ET), in opposite the higher b means higher α. (i.e. increasing ET).

Yet from equation 15, runoff is equivalent to exponential of negative aridity index.

$$R \approx e^{-b\alpha}$$

Lower *b* generates the higher R. For example, b value in the North River is 0.6 in

1960s and 0.18 in 1980s. When we apply a simple calculation on these two b values, we obtain a result as follow:

$$e^{-0.60} = 0.549$$

$$e^{-0.18} = 0.835$$

It simply means that lower b indicates the lower ET, thereby generating higher runoff.

**p6314: L 7-8: is the difference in parameter "a" between these two watersheds statically significant (i.e. the t-test result)?**

According to the t-test result, the difference in a value between these two watersheds is statistically significant (*p*=0.030; <0.05).

**p6315: L3-5: This conclusion seems not right. According to equations 8-11, we can get the following equation: delta (L/P) = -delta(R/P) + delta (exp(-alfa/P). If the second term do not change (i.e. equals zero), the delta (L/P) is exactly the same as delta(R/P) but with an opposite sign. According to equation 5, alfa is E0/P which will be related with P, T, and Ra; according to equation 15, alfa might be b*alfa of which "b" is estimated from regression. So from figure 4 we can only get the conclusion that the term "b*alfa" (i.e. climate factor) has minor effects. Authors need explain with more details about the linkages between "deforestation" with "increasing annual river runoff". Authors also need to clarify in equation 10 if the alfa is adjusted/regressed (equation 15) or not.**

We cannot draw a conclusion that climate has minor effects on annual runoff changes based on the equation (a) because all variables are relative to P in this equation. Although the second term only changes slightly (i.e. equal to zero), it does not mean that $\Delta R_C$ equal to zero, but the $\Delta R_C/P$ (equation c).

$$\Delta\frac{L}{P} = -\Delta\frac{R}{P} + \Delta\left(e^{-\alpha}\right) \qquad \text{(a)}$$

$$\Delta\frac{L}{P} = -\Delta\frac{R}{P} + \Delta\frac{P\left(e^{-\alpha}\right)}{P} \qquad \text{(b)}$$

$$\Delta\frac{L}{P} = -\Delta\frac{R}{P} + \Delta\frac{R_C}{P} \qquad \text{(c)}$$

$$\Delta L = -\Delta R + \Delta R_C \qquad \text{(d)}$$

$$\Delta R = \Delta R_C - \Delta L \qquad \text{(e)}$$

$$\Delta R = \Delta R_C + \Delta R_L \qquad \text{(f)}$$

What is the difference between $\Delta R$ and $\Delta R/P$? The first one refers to the changes in runoff, while the second one is the changes in water yield. Water yield demonstrates the catchment ability on absorbing the precipitation and yielding the runoff (Huang *et al.* 2014). Catchment with water yield of 0.7 means about 70% of precipitation is transferred into runoff and the rest 30% lost in the catchment. Change in water yield is determined by the catchment storage. When catchment reaches its saturation, the water yield may subsequently increase.

For example:
$R_1$=1000 $P_1$=1500 $R_{C1}$=823 $R_{L1}$= 177
$R_2$=700 $P_2$=1100 $R_{C2}$=604 $R_{L2}$= 96
Results:
I. $\Delta R/P$= -0.03 $\Delta R_C/P$=0.00 $\Delta R_L/P$= -0.03
II. $\Delta R$= -300 $\Delta R_C$= -220 $\Delta R_L$= -80

Note: R= runoff (mm); P=precipitation (mm); $R_C$=climate runoff (mm);
$R_L$=land runoff (mm)

The above two results give us two different conclusion. From the first result, we see $\Delta R/P$ is exactly equal to $\Delta R_L/P$. In other word, land-use change is the major driver of the changes in water yield. Differently, the second result shows both $\Delta R_C$ and $\Delta R_L$ have the similar tendency on $\Delta R$. And from the value we get, it shows that climate play more significant role on runoff changes, while land-use changes tend to reinforce the impact of climate. By considering the main objective of this paper which was to identify the specific impact of land use changes on annual runoff dynamic, the second approach sounds more accurate. We thereafter realized that Fig.4 is no longer able to describe the effect of land-use changes on runoff changes.

This is also related to the next comment which mentioned that **Fig.4 is confusing. In this figure L is evaporation from land change; while R is actual run off change (climate + land change). It's better to use the same variable such as delta (R) from land change and delta (R) from all change, etc.**

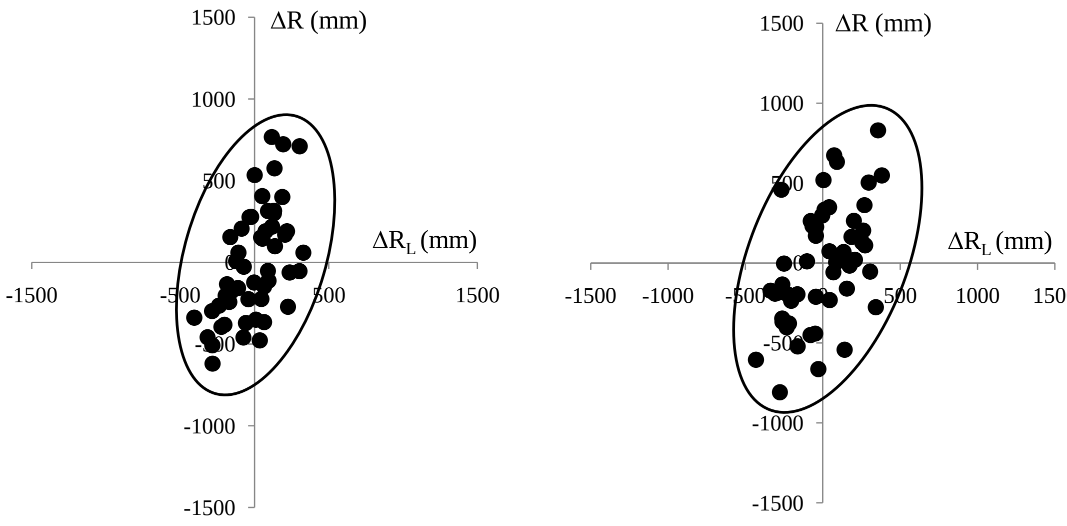
(a) North River
(b) West River

**Fig.A.** Land-use contribution to runoff changes

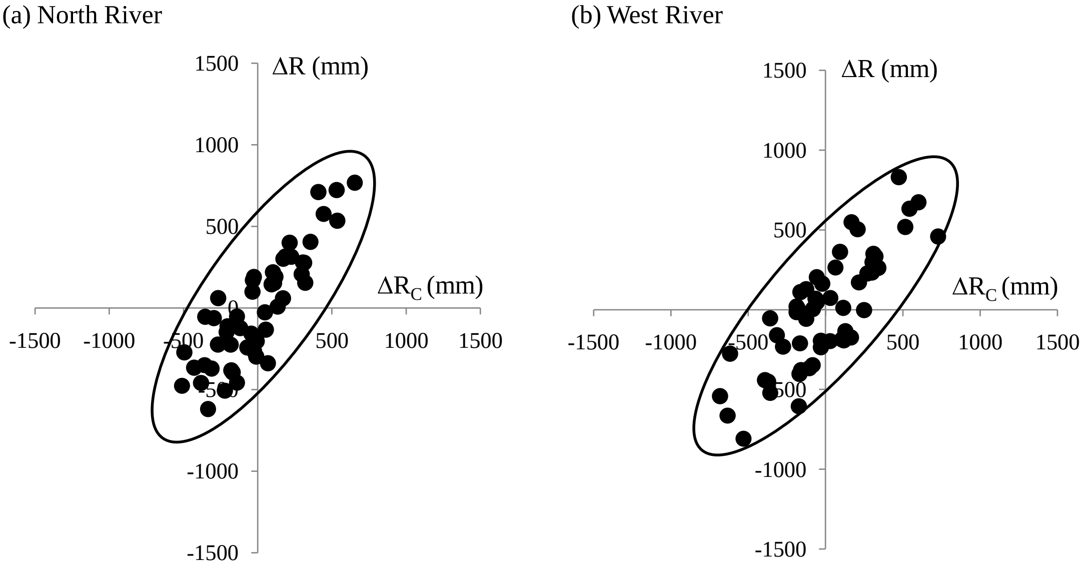

**Fig.B.** Climate contribution to runoff changes

Fig. A and B show that land-use changes strengthen the impact of climate on annual runoff dynamic, which is consistent with the conclusion written in p6315: L3-5 where *Annual runoff dynamic in the North River and West River were strongly reinforced by land use changes over the past 53 year as most of the points were scattered on the II and IV quadrant.*

More details explanation about the linkages between deforestation and increasing annual river runoff will be put forward in the manuscript. And α in equation 10 is adjusted to equation 15.

**Fig. 5 and P6315: L6-9: the naming of "dry" and "wet" years in this manuscript is not consistent with common sense. Authors may need a special term for this concept. Here, I think authors is using "dry year" and "wet year" as the period with decreasing and increasing trend in runoff, respectively. While in each period, authors calculate the relative contribution with equations 12-14 & 7. This paragraph need rephrase**

Thanks for the correction. In this manuscript, dry year and wet year refer to the period with lowest and highest runoff in each decade. And these terms actually can be only used for the extreme hydrological year (Aubert *et al.* 2013). Hence, the new term of high runoff and low runoff period seems more acceptable than the prior term.

P6315: L-6-9 is rephrased into *The relative impact of land-use changes on the inter-annual variation of river runoff is shown in Fig.5.*

Before it written as: *The results of L-R diagram were supported by quantitative estimation of the relative impact of land-use changes on annual runoff dynamic between dry year and wet year over the past five period observations (Fig.5).*

**Fig. 3 indicates that the relationship between runoff and precipitation and aridity index has large variations during different time period; while the authors use more simpler equation (i.e. equation 10) to count for the climate-induced ET (so to runoff), which may introduce much uncertainties to explain all the remnant changes (i.e. actual runoff minus climate-induced runoff) to land-caused change.**

Before using the model developed by Scheiber (1904) to estimate climate-induced runoff, firstly we observed our data and found runoff has linear relation and negative exponential relation with precipitation aridity index, respectively, as we can see in Fig. 3. Later we discovered that this pattern was consistent with the hydrological model developed by Schreiber (1904). In this study, we assumed that large variation in the relationship between runoff and precipitation and aridity index during different time period was due to human activities influence, in this study was the land-use changes. As reported by Zhang *et al.* (2011), human activities impact on hydrological process can be detected from non stationary relationship between the annual rainfall and runoff in North China watershed.

## References

Aubert A H, Chantal G O, Philippe M. Annual hysteresis of water quality: A method to analyse the effect of intra- and inter-annual climatic conditions [J]. Journal of Hydrology, 2013, 478: 29–39

Huang, J.C., Lee, T.Y., and Lee, J. Y.: Observed magnified runoff response to rainfall intensification under global warming, Environ. Res. Lett., 9, 1-7, 2014.

Zhang, Z., Chen, X., Xu, C. Y., Yuan, L., Yong, B., and Yan, S.: Evaluating the non-stationary relationship between precipitation and streamflow in nine major basins of China during the past 50 years, Journal of Hydrology, 409, 81–93, 2011.