Response to Referee #3's comments

General Comments： This research investigated the linkages between ENSO/PDO signals and precipitation, streamflow in China during the last 100 years, which could help understand the potential impacts of t climate change on the precipitation and subsequently the streamflow in China. The topic is of interest to HESS. However, the analysis results presented in the paper are not sufficient enough to justify the conclusion with respect to the streamflow impact in China. Additional analysis of the streamflow records is necessary. The manuscript could be published after substantial revisions.

Many thanks for the invaluable comments from the reviewer for improving the quality of our manuscript. Each of reviewer's comment has been responded carefully, and also, the following sentence was added in the acknowledgement section: "*We wish to thank the editor and all anonymous reviewers for their invaluable comments and constructive suggestions used to improve the quality of the manuscript*".

Specific Comments:

1) In Section 2.1, since China covers different climate zones, the background information of the geographical divisions and the four river basins selected would be provided. The reasons for the selection of the four river gauging stations as well as the metadata of the streamflow records are necessary.

We totally agree with the reviewer, and more background information about the four major river basins (*including the drainage area, data periods, annual mean streamflow/precipitation, the geographical characteristics of the gauging stations…*) have been added in the revised manuscript (see the added paragraph below and Table R1). Actually, there are only a few gauging stations (which generally locate at the main channels of several big rivers and play an important role on the water resources in China) have continuous streamflow observations during the last 100 years in China. The river basins chosen in this study cover the locations from approximately the northern China to south and main representative climate zones in China. Therefore, they are expected to be able to represent the water resources variability over China. For the precipitation data, as we mentioned in the manuscript, the spatial extent we used is the entire China extracted from the CRU gridded data. Moreover, the streamflow data used in the study is the quality-controlled observed records obtained from the National Hydrology Almanac. Additionally, there is a mistake in the Table 1 in the old version because that we did not use the 100 years data at Huayuankou station due to the missing data. We used continuous 100 years annual streamflow record at Sanmenxia station and monthly streamflow record at Huayuankou station to represent the streamflow change in Yellow River. For more information, please refer to the added paragraph below and the modified Table 1.

"Only a few gauging stations have continuous observational records during the last 100 years in China. The gauging stations were chosen considering the location, length of the observation period and quality of the data observed. The four selected gauging stations are Harbin Station in Songhua River basin, Shanxian Station (renamed Sanmenxia Station in 1950) in Yellow

River basin, Hankou Station in Yangtze River basin and Wuzhou Station in Pearl River basin. All of them are located on the main channel of the rivers as control stations. The location of the gauging stations and the four river basins can be referred to Fig.1. Songhua River basin, Yellow River basin, Yangtze River basin and Pearl River basin, being the four major large river basins in China, cover approximately from the north to south of China and almost climate types of China. Songhua River basin located in the north of northern China belongs to the zone of temperate monsoon climate. Yellow River basin can be divided three sub-regions (i.e. the eastern monsoon sub-region, the arid and semi-arid sub-region, and the high-elevation subregion), which is accordance with the three natural zones in China (Liang et al. 2014).The southern part of Yangtze River basin is close to the tropical zone and the northern part is close to the temperate zone. Pearl River basin covers a region of subtropical to tropical monsoon climate straddling the Tropic of Cancer. The study basins are expected to be able to present the streamflow variability over China under climate change. Then, in this study, one hundred years (1901-2009) of continuous quality-controlled annual streamflow data and fifty to a hundred years of monthly streamflow data were collected from National Hydrology Almanac."

Besides the precipitation, the impacts of human activities on the rivers in China over the study period should be taken into account.

We totally agree with the referee that the observed streamflow is affected by human activities over the past 50 years, and there is no doubt that "*natural runoff*" is the best choice for researching the linkages between streamflow and ENSO/PDO. However, the methods for estimating "*natural runoff*" always require many detailed information which is extremely difficult to collect in China. Moreover, the accuracy of the naturalized runoff series is hard to test. Actually, we aimed to examine whether the observed streamflow was also affected by ENSO/PDO after human activities/land use changes in this study. Considering the observed streamflow is a mixed signal influencing by climate variability and human activities, the precipitation data which has limited impacts by human activities was used simultaneously for comparing its responses to ENSO/PDO with that for streamflow. Some comparisons and discussions could be found in our paper, for example:

(1) P4244 L8-L10: *"Moreover, the ENSO influences on streamflow are spatial-temporally consistent with that on precipitation for the major river basins over China with obviously differences among months and basins."*
(2) P4247 L2-L4: *"The 'annual' streamflow changes shown in Fig. 7 are basically consistent with those for precipitation during warm and cool PDO phases against the long-term average, although there are no significant trends tested."*
(3) P4249 L21-L29: *"Overall, the El Niño/La Niña-related precipitation/streamflow experience similar variability during the warm/cool PDO phase except for the Songhua River basin in the cool PDO phase. Moreover, the streamflow, which is also influenced by many other factors such as global SST, longwave radiation, snow and human activities (Xu et al., 2007), seems to be more sensitive than the precipitation during the El Niño/La Niña periods in both warm and cool PDO phases (Fig. 9). However, the general influence patterns of the combined effects are basically consistent."*

2) In Chapter 3, the description of the impacts found in the different regions of China and the four river basins would be improved to give readers a general picture of the findings.

As shown in Fig.3~Fig.9, the influences of ENSO/PDO on precipitation/streamflow are different for each river basin and even for different parts of one basin which is actually not easy to give a general picture. Consequently, we only described the results for each river basin or for the different parts of China and gave a general description in the Section "*Conclusion and Summary*" in this manuscript.

Regarding streamflow impacts, additional analysis of the streamflow records is necessary to show the relationship between streamflow and precipitation, and the impact of human activities in the rivers should be addressed too. Correspondingly, the discussion of the findings should be enhanced.

Actually, in this study, we analyzed the ENSO/PDO impacts on precipitation/streamflow using the composite precipitation/streamflow conditioned with ENSO/PDO periods. Following this approach, the relationship between streamflow and precipitation cannot be analyzed through the respective of time series. However, we found they do show consistent spatial responses during different ENSO/PDO periods. We have revised/added some descriptions/discussion in the revised manuscript. Additionally, regarding to the impact of human activities, please refer to the responses (*second part*) of the specific comments 1. Thanks for your comments.

Table R1 Background information of the four selected river basin in this study

River basin	Station (Location)	Drainage area (km^2)	Annual streamflow record period	Monthly streamflow record period	Annual mean precipitation (mm)	Annual mean streamflow (10^8 m^3/a)
Songhua River (I)	Harbin (126°46′E, 45°45′N)	390,526	1901-2009	1901-1948,1953-2004	491 (1901-2009)	386 (1901-2009)
Yellow River (II)	Sanmenxia (111°22′E, 34°49′N)	688,421	1901-2009	-	385 (1901-2009)	489 (1901-2009)
Yellow River (II)	Huayuankou (113°40′E, 34°54′N)	730,036	-	1950-2004	449 (1901-2009)	555 (1950-2004)
Yangtze River (III)	Hankou (114°18′E, 30°37′N)	1,488,036	1901-2009	1901-2004	887 (1901-2009)	7256 (1901-2009)
Pearl River (IV)	Wuzhou (111°30′E, 23°48′N)	329,705	1901-2009	1950-2004	1307 (1901-2009)	2175 (1901-2009)