

## ***Interactive comment on “Linkages between ENSO/PDO signals and precipitation, streamflow in China during the last 100 years” by R. Ouyang et al.***

**R. Ouyang et al.**

liuwb@itpcas.ac.cn

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This paper elaborates the separate and combined influences of ENSO / PDO signals on monthly and annual precipitation over China across a period of 100 years (1901–2009). The authors use monthly and annual runoff data for their analysis of four river basins (Songhua River basin, Yellow River basin, Yangtze River basin, and Pearl river basin) from north to south of China. The ENSO (El Niño and La Niña events) and PDO phases (warm / cool) were used to stratify the precipitation and streamflow time series for analysis. The precipitation and streamflow time series includes monthly (multiple year mean value) and annual (sum of monthly) values. Wilcoxon signed ranks test were

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applied to identify if significant differences exist in average precipitation and streamflow between PDO warm and cool phases, as well as between El Niño and La Niña periods. Then the impacts of ENSO and PDO, as well as their combined impacts on precipitation and streamflow were quantified. The topic of the MS is interesting and within the scope of HESS. The paper is well structured but language revision would improve the readability of the MS. Before to get published the authors have to discuss the following issues in more detail:

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".

1. In addition to biophysical factors (as precipitation) streamflow is affected by human activities. As the authors mentioned and many studies have shown the streamflow of large river basins in China have significantly changed over the time. Numerous studies have shown that these changes were caused by human activities. Against this background, to link the ENSO / PDO signals to streamflow makes therefore only sense if there is no significant change / trend (trend test) in streamflow over the entire study period.

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 activ-

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ities 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. The authors discussed in the introduction that if a strong relationship between streamflow and ENSO / PDO can be found, streamflow forecasting can be improved. However, the authors did not return to this issue in the result/ discussion section. What is the contribution of this study to use ENSO/PDO signals as a potential predictor for streamflow forecasting?

Thanks for the referee’s suggestions. The main contributions of this study are: (1) The linkages between precipitation/streamflow and ENSO/PDO were investigated using 100 years’ data; and (2) the combined effects of ENSO and PDO were considered. If the ENSO/PDO has significant teleconnections with precipitation/streamflow, then the ENSO/ PDO signals will be potential predictors for streamflow forecasting. This study is only the first-step work (focus on the teleconnections) for adding our basic knowledge on the influences of ENSO/PDO on the water resources in China. We totally

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agree with the reviewer that streamflow forecasting works are particularly interesting to investigate, but they are beyond the scope of this study and we will do it in the future works. Additionally, the potential implications of this study for streamflow forecasting in the future have been pointed out in the Section “Summary and Conclusions”.

Please also note the supplement to this comment:

<http://www.hydrol-earth-syst-sci-discuss.net/11/C2015/2014/hessd-11-C2015-2014-supplement.pdf>

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