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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Teleconnection analysis of runoff and soil moisture over the Pearl River basin in South China" *by* J. Niu et al.

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We thank the reviewer for his/her constructive comments and useful suggestions. Our detailed responses to the review comments are as follows.

General Comments: The manuscript investigates the teleconnection between two climatic patterns (ENSO and IOD) and the hydrological processes over the Pearl River basin using wavelet methods. The study in this paper is suitable for the scope of the journal, and the paper is readable. However, some revisions should be carefully done for making the manuscript improved enough for publication.

Author Response: We thank the reviewer for his/her positive evaluation on the suitability of the topic of the manuscript and for the comments and suggestions to further

improve the manuscript.

Specific Comments:

Review Comment 1: Overall, the paper lacks sufficient background materials to provide the context for the study and previously relevant studies about this issue in the Pearl River basin. The background described in "Introduction" is too simple, and the main difference between this study and previous studies is not clearly explained.

Author Response: We agree with the reviewer. We can revise the manuscript accordingly, including several new references. We can also clarify the main differences between the current study and earlier studies. The following contents explain how this can be done in the revised version.

"Many recent studies have helped advance our understanding of the hydrological variability over the Pearl River basin in South China and the surrounding regions, including those on precipitation (e.g. Yang et al., 2010; Fischer et al., 2012; Chen et al., 2011; Zhang et al., 2012) and runoff (Zhang et al., 2008; Niu and Chen, 2010), among others. For instance, several studies have reported that the significant fluctuations in precipitation over the basin are associated with atmospheric circulation patterns (Li and Zhou, 2012; Niu, 2013) through influencing the monsoon system over the region (Zhang et al., 2010; Zhou et al., 2012). Zhang et al. (2013) examined the meteorological drought tendencies based on the standardized precipitation index by employing copula functions and Mann-Kendall trend test. The Pearl River basin was categorized into six regions based on latitude, longitude, elevation, and the mean annual precipitation using the L-moments approach (Yang et al., 2010), and four homogenous regions based on the changing properties of precipitation using the k-mean clustering algorithm (Zhang et al., 2012). Zhang et al. (2009) analyzed the scaling and persistence futures of the long daily streamflow series for four hydrological stations in the mainstem of the East River. The changes of observed water discharge and sediment load (1950s-2004) were analyzed by Zhang et al. (2008) for nine stations in the Pearl River basin, which is only

performed on annual time scale. For the whole Pearl River basin, the previous studies were mainly performed based on observed data (e.g., Cui et al., 2007; Yang et al., 2010; Zhang et al., 2012)." "Following up on the studies by Niu and Chen (2009, 2010), this study evaluates the sub-basin hydrological processes over the Pearl River basin in response to two large-scale climatic patterns, the El Niño-Southern Oscillation (ENSO) and the Indian Ocean Dipole (IOD), towards improving our understanding of basin-featured flood and drought occurrences. Compared with the previous studies over the Pearl River basin, our focus in this study is on runoff and soil moisture processes, with particularly on sub-basin scale basis."

Review Comment 2: The potential significance of this study is not explained enough. Although some conclusions have been speculated, but they are not enough, and the importance of the conclusions is not expressed. As a result, I do not ensure the importance and significance of this study.

Author Response: The importance and significance of this study can be realized in terms of two aspects: (1) Regional responses of hydrologic processes to climate variations are often different from one river basin to another. Accordingly, the different sub-basins of a large-scale river basin often play their own roles in modulating the influences of climatic patterns. Therefore, studies on response features of the runoff/soil moisture will improve our understanding for the basin-featured flood and drought tendencies and will, thus, be useful to examine the teleconnection analysis of runoff and soil moisture on a sub-basin scale basis. (2) Our inferences on the occurrence of extreme hydrological events incorporate the information derived from the bandpass-filtered time series of runoff/soil moisture. The scientific foundation of this approach is that the impactful appearance of small-scale activity (variability) is supported by larger-scale activity (see Kumar, 1996 for some details).

Review Comment 3: The title of the Section 2.2 is "Runoff and soil moisture", but the authors mainly discussed the VIC model, model simulation and large-scale climatic patterns in this section. The section 2.2 should have a more suitable title.

Author Response: We agree with the reviewer. It would be more appropriate to have the title "Model simulation" for Section 2.2 and "Forcing and output data" for Section 2.2.2. We would be happy to make the changes.

Review Comment 4: The Section 3 mainly describes the wavelet methods used in this study. I suggest that some contents about the wavelet function used and wavelet method in "Introduction" moved here.

Author Response: We agree with the reviewer. We would be happy to move the contents related to the wavelet function to Section 3.

Review Comment 5: In Figure 2 in Section 4, I do not understand why the annual periods of these monthly series are not obviously? Can the authors explain this point?

Author Response: The wavelet-based analysis is carried out for the anomalies of monthly runoff and soil moisture. This can be easily clarified through a sentence "In Fig. 2a-i, the anomaly data are obtained by removing monthly mean for the period of 1952–2000".

Review Comment 6: In Section 5, the authors mainly investigate the influences of climatic patterns on droughts and floods in the study area. There are many relevant studies about this issue, what is the relations and difference between this study and other relevant studies?

Author Response: The major difference between this study and other relevant studies is that we incorporate the information of the high or low hydrological variance for different coherent regions (on sub-scale basis) in the basin. This information is derived from the bandpass-filtered time series of runoff/soil moisture (see details in Section 4.3). The scientific foundation relies on that the impactful appearance of small-scale activity (variability) is supported by larger-scale activity (Kumar, 1996). Our inferences of extreme hydrological events (i.e., the flood event in 1994 and the drought event of 1963) are certainly also based on and benefited from the previous studies, such as

Ding and Chan (2005), Torrence and Webster (1999), Behera et al. (1999), Huang and Wu, (1989), and Zhang et al. (2007). We have properly cited those references accordingly.

Review Comment 7: This paper uses many contents in the reference (Niu, 2010), so it may be more suitable to add some relevant contents to more clearly explain these topics in this paper.

Author Response: We agree with the reviewer. We can revise the manuscript accordingly, by including the following text.

"The main procedures for the PCA application in this study include: (1) a covariance matrix is obtained by using the wavelet power spectra for s (equal to 49) timescales of one of runoff/soil moisture in 10 sub-basins; (2) decomposing the covariance matrix to get eigenvectors of the Matrix, which accounts for the maximum amount of the joint variability of anomalies of initial wavelet power spectrum at each sub-basin; (3) the new variables are produced after projecting the data on the obtained eigenvectors; (4) the first three principal components are selected for runoff and soil moisture respectively; (5) each sub-basin was then classified as belonging to the mode where its coefficient of the eigenvectors (i.e., the length of the vector projected on corresponding direction) was largest absolute value."

Review Comment 8: Need wordsmithing and language editing in the manuscript.

Author Response: We agree, and we will do this in the revision.

Review Comment 9: Some new relevant references could be added.

Author Response: Yes. The following references, among others, are relevant to this study, and we will add them in the revised version.

Chen, Y.D., Zhang, Q., Lu, X.X., Zhang, S.R., Zhang, Z.X.: Precipitation variability (1956–2002) in the Dongjiang River (Zhujiang River basin, China) and associated large-scale circulation, Quaternary International, 244, 130–137, 2011.

Zhang Q., Xiao, M.Z., Singh, V.P., Chen, X.H.: Copula-based risk evaluation of droughts across the Pearl River basin, China, Theor. Appl. Climatol., 111, 119–131, 2013.

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