

## ***Interactive comment on “Paleoclimatological perspective on the hydrometeorology of the Mekong Basin” by T. A. Räsänen et al.***

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Editor's comment:

The discussion paper has received comments from three reviewers, all of which have been constructive, although one must note that Reviewer #3 has raised serious concerns about the novelty and contributions of the paper.

First of all, this is a discussion journal and it is incumbent on the authors to post their responses to the reviewers separately in case the reviewers want to respond again. This is important for the quality of the paper, and will be weighed carefully in any decision to proceed to publication in HESS.

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I would like to see a careful and considered response to Reviewer #3, who questions the novelty of the paper (methods used are standard), and also the strength of the contributions to the literature. The question in the reviewer's mind (and in my mind) is what has been learned from this study that is transferable to some other place. Just to say that hydrologic variability has increased in recent times in the Mekong without any attribution is a concern for the eventual publishability of the paper in HESS. I would like to hear from the authors how they intend to handle the revisions in a way to allay these concerns. I suspect that the paper has to undergo careful (and substantial) revisions. I am hoping that Reviewer #3 will respond again, and in this way strengthen the arguments for publication. I look forward to this discussion and a further evaluation.

Once I find the authors' responses I will again post a comment with recommendations for a revised manuscript (if appropriate).

Author's response to editors comments:

We are very grateful for the thoughtful and constructive comments submitted by the referees. We have taken all their comments carefully into account when revising the paper. We believe that this has resulted in significant improvements to it.

As requested by the editor, we paid special attention to the comments by Referee #3 regarding the novelty and scientific contribution of our paper. We do believe the manuscript provides a novel scientific contribution, but we agree that these aspects were not very clearly formulated in the original manuscript. As such, we have made major revisions to the manuscript to reflect both the novelty in its approach and its significant scientific contribution to research on hydrological variability in the Mekong Basin, and also in the wider Monsoon Asia region. Below, we also provide details of our main justifications.

So far, basin scale hydrological variability research in Asia has mainly focused on the 20th century, while long-term palaeohydrological research in general has focused on the trends of average conditions without assessing their inter-annual variability. Our

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approach developed in this manuscript bridges these two and thus aims to provide a robust approach to assess the long-term variability of hydrometeorological conditions and discharge at the river basin scale, for basins in Monsoon Asia. This is also acknowledged by the Referee #3: "The paper attempts to link systematic measurements with paleohydrological data – an approach which is extremely interesting".

This is important, as the region is home to more than half of the world's population and a large part of their livelihoods, and moreover food security, is based on local hydrometeorological conditions. If the current, observed, variability can be put into the longer time perspective, it would help to start to understand the stresses of possible changes in hydroclimatic variability on traditional livelihoods and aquatic ecosystems. Therefore, although we use published datasets and existing methods, as mentioned by Referee #3, we argue that the overall approach, under which we use these datasets and methods, is novel and new. It should be further noted, that our approach can be used in any large river basin in Monsoon Asia (within the extent of the MADA dataset) for which there are enough discharge data available to assess statistically the relationship between PDSI MADA and discharge.

We selected the Mekong Basin for a case study to test this approach, as there exists growing amounts of information on the observed variability in its discharge (e.g. Delgado et al. 2010; 2012) and good data coverage of both discharge and MADA datasets.

Referee #3 questioned the scientific contribution of the findings of our article arguing that the first of the two main messages is already published elsewhere (Delgado et al 2012) and that we were not able to explain the increased variability of the last decades within the 700-year study period (see first comment of the Referee #3). We agree on the latter point of criticism; our original manuscript did not explain the increased variability. When revising the manuscript we paid careful attention to this and have extended our analysis to cover this part of the story as well. We found that periods with high hydrometeorological variability were associated with high ENSO activity. This

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is based on our Wavelet analyses and also supported by literature (e.g. D'Arrigo et al 2005) who found high ENSO activity within the periods corresponding to our findings. Thus, the high variability can be explained at least partly by high ENSO activity. However, we disagree with the first point of Referee #3, since Delgado et al (2012) or (2010) do not use PDSI or MADA in their analysis in the first place (those are not mentioned in their articles). Their analysis is based on the observed discharges, which they link for example to PDO (Pacific Decadal Oscillation), to which acronym Referee #3 might have mixed the PDSI with. So far there has not been any study, to the best of our knowledge, that uses MADA or some other tree ring based PDSI palaeo proxy data on river basin scale and correlates that with the observed discharge. This supports the novelty of our approach.

Our assessment, moreover, extends the findings of Delgado et al (2010; 2012) in short-term (20th century) hydrological variability in the Mekong, as PDSI is based purely on meteorological variables while discharge is also reflecting other human induced changes in the basin, such as landuse change, irrigation and reservoir operation. Our findings thus confirm that the high variability in the Mekong during the recent decades is of climatic origin.

We hope that these responses to the editor comments and the main comments by Referee #3 are sufficient to show the novelty and scientific contribution of our paper. We paid special attention to communicating these issues adequately in the revised manuscript. Moreover, based on the excellent comments by the all the referees, the paper was substantially revised and several parts were re-written, removed and some new analyses were added.

The major changes in the revised manuscript are:

1. The novelty and scientific contribution of the paper are clarified in the revised paper. The novelty and scientific contribution are as follows (see also our response to editor's comment above):

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1a. Novelty: i. A new approach was developed to assess hydrometeorological and discharge variability at the river basin scale on a palaeo time-scale. The approach is based on Monsoon Asia Drought Atlas (Cook et al. 2010). We tested the approach using the Mekong River Basin as a case study. Our findings suggest that the approach is a robust tool for detecting patterns in inter-annual variability and average conditions in the Mekong River's discharge; ii. The approach is not case specific and it can be used in any large river basin in Monsoon Asia region; iii. The developed approach contributes to studies on catchment hydrology and future climate change studies by linking instrumental measurements with paleohydrological data

1b. Scientific contribution (new findings): i. PDSI MADA was found to be a good proxy for discharge in the Mekong; ii. In the Mekong the hydrometeorological variability in the post 1950 period was significantly higher than elsewhere in the 700-year study period (1300-2005); iii. The increased variability was associated at least partly to ENSO activity.

2. We removed excess analyses from the revised paper, as requested by Referee #3. The current methods are selected so that they examine specific questions and do not overlap with each other.

3. We added analysis on ENSO to further examine the usability of our approach in explaining the increased variability in post 1950 period.

4. We have re-written the Introduction section and modified all other sections to better highlight the new findings and novelty of our approach.

All referee comments have been addressed and the paper has been revised accordingly. We believe that we have responded satisfactory to all suggestions as specified below. We would thus be most grateful if you would consider our revised manuscript for publication in HESS.

With best regards,

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Timo A. Räsänen

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 9, 12729, 2012.

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