

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

### **Anonymous Referee #1**

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### **General comments**

This paper aims to examine the relationship between a paleoclimatological reconstruction of the Palmer Drought Severity Index for the Mekong Basin and Annual Discharge at the most downstream gauging station. Based on this relationship it then draws conclusions about the paleohydrological behaviour of the Mekong. The paper is generally well written and present topical material for HESS.

I first have a couple of overall comments to make.

Plots are presented that use "standardised" flow and PDSI. The standardisation presumably occurred in data pre-processing but this aspect of the methodology has not

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been discussed. Please specify how the data has been standardised.

In section 3.2.6 an extreme value analysis is described. The methodology used is not at all clear. At one point it says "Thus we fitted the GEV to the original PDSIM series to examine the extreme wet years." Extreme value distributions should be fitted to some sort of extreme value series, such as the maximum daily flow from each year. That is you need to identify extremes in some manner. It is not clear if you have done this (nor how you could do it from this data series, which seems to be just one value for each year)? This section needs to be rewritten for clarity or omitted if this is not an extreme value analysis.

There is an aspect of the statistical analysis that the authors do not seem to have accounted for that is compromising some of their results. At 12745 line 12 and other places where p values are calculated, moving average data seems to be input into the analysis. This means the data points being analysed are not statistically independent, whereas that was presumably assumed if standard tests were used. In fact with a 21 year moving average and 95 years of data, there are few data points to assess the correlations described here (similar issue with trend tests for variance on line 19). Alternative tests or adjustments for the reduction in degrees of freedom resulting from the averaging will need to be used to gain valid results. This will also need to be explained in the methodology.

### **Specific comments**

12734 around line 15. Please show locations that are specifically mentioned (Tibetan Plateau, Annamite Mountain Range) on Figure 1.

Section 2. The introduction to the Mekong River Basin is quite broad (and interesting) but it is not quite clear why it is being given. In particular the various changes occurring in the basin will impact the hydrology but this paper is about climatological effects. Issues such as the impact of dams are not considered in the paper, although after reading this introduction I thought they might be. I would drop out the issues that are

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irrelevant to the paper.

Section 3 paragraph 1. I found this paragraph a little unclear as I was unsure what PDSI data were being referred to and what their source was (paleo reconstruction only or a combination of climate station and paleo reconstruction). While this is explained later, a sentence alerting the reading to the fact that all PDSI data used in the paper is from MADA and that it is the paleoclimatological reconstruction from 1300-2005.

12737 line 10. It would be useful to say what percentage of the entire basin area is captured by the gauge at Shung Treng?

12737 line 11-13. The paper does not specify anywhere what the JJA PDSI actually represents. I assume it is the mean PDSI over these three months but this should be clarified.

12737 line 15-21. The issue of the lack of a rating curve before 1950 and its impact on discharge data reliability is discussed. This is very important to the paper, given the need to establish that the PDSI is a good surrogate for flow. What is known about how quickly the rating curve for the Mekong changes? If the change is fairly slow, this brings this statement (that the "time series is not accurate for analyses at an annual resolution, but sufficient for analysis of long-term patterns") into question i.e. if it is a slow drift it will affect and 21 year moving average. If most of the change is at higher temporal frequencies then the MA will remove the noise. Do you know anything about this station that would provide insight into this such as whether this is an alluvial or bedrock section?

12738 line 24 to 12739 line 2. This sentence talks about 3 year dry periods in the raw and moving average data as being multi-year and decadal droughts. I am unclear how 3 years makes a decadal drought?

12740 line 3 suggested rewording of first sentence "The PDF describes the relative likelihood that a variable will take a given value."

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Section 3.2.5. It is not obvious why you are evaluating the PDF - perhaps explain.

Section 4. I would reword the entire first paragraph to be: "First we present the comparison of  $PDSI_{ST}$  and discharge at Shung Treng to determine how well the basin average PDSI describes the annual discharge of the Mekong over the period 1910-2005. Second we present the results from the analysis of  $PDSI_M$  where we examine the characteristics of the  $PDSI_M$  in the time and frequency domains."

12741 line 2 and elsewhere. This paper deals with the annual discharge of the Mekong, which is one narrow characterisation of the hydrology of the Mekong. I think you should use the term "annual discharge" rather than "hydrology".

12741 line 4-6. Important differences exist here that seem to be glossed over. The correspondence between annual flow and PDSI for the first half of the data series is not that great (at times they are at opposite extremes) and then there is a moderate relationship. Overall 30% of the temporal variation is explained - that is 70% is error. A little more discussion of this is important as the rest of the paper depends critically on establishing this relationship. This is recognised later in the paper (12745 lines 8-10) where the comment " Thus our analyses (visual comparison and correlation analysis of annual and smoothed data) indicate that the PDSI<sub>ST</sub> is a more efficient proxy for the 10 hydrological conditions on multi-annual and decadal scales than on an annual scale." is made.

12741 line 21-22. The statement about standard deviation doubling puts quite a lot of weight on one extreme 2-3 year period around 2000. Without that event, the variance (not sigma) has increased by more like 50-100% according to Figure 2c, depending whether you look at PDSI or flow.

12741 line 23-25. I would like to see the histograms rather than the fitted pdfs.

12742 line 19-21. Explain what these arrows mean. i.e. up = flow leading PDSI, down = flow lagging PDSI, left = ?, right = ?

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12742 line 20. The flow lead the PDSI? - This is pretty hard to explain from a process perceptive. What does this mean?

12742 line 25-26. I think this statement needs to be tempered - a strong correlation was found for smoothed data but not annual data.

12744 line 17. As mentioned earlier this extreme value analysis is unclear to me as the methodology hasn't been explained properly.

12745 line 18-20. There is a lag between runoff generation and discharge due to routing - the key rainfall period is probably more like May-September. Certainly these are the main monsoon months in Vientiane.

12745 line 21-22. This statement is not strictly correct. The link to a "clear ENSO signal" has not been demonstrated as this wasn't analysed. The frequencies do correspond, however.

12746 line 3-5. It is not clear to me how the uncertainty in the rating would contribute to phase differences or phase shifts in the data.....could you elaborate please.

Section 5.3. It might be useful to distinguish between meteorological drought (PDSI) and hydrological drought (streamflow) in this discussion.

Figure 5 and its discussion. At present I don't think this figure adds anything more than what is evident from Figure 2D. I would suggest to delete it.

### Technical corrections

12733 line 23. Please define the acronym MADA where first used. (and remove the later definition)

12736 line 24. Replace "departure" with "demand".

12741 line 22-23. The sentence "The results also indicate...." is repeating lines 8-10. Delete it.

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12744 line 2 "their" should be "the"

12744 line 3 should be "closer to an AR2 process"

12744 line 10 "observed elsewhere in the period 1300-2005" would be better

12744 line 14 "to" should be "with"

12750 line 8. This should be "...with the measured annual discharge..." for clarity.

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