

## ***Interactive comment on “Flood trends and variability in the Mekong river” by J. M. Delgado et al.***

### **Anonymous Referee #1**

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The authors present a well-written and well-reasoned case for paying more attention to changes in variance, taking the annual maximum runoff of the Mekong as an example. They argue that to describe these changes the proper distribution, in this case a NS-GEV, must be employed, because simpler assumptions such as a gaussian will give a mix of location- and scale-parameter changes, whereas a non-parametric test such as the Mann-Kendall test may lack the power to detect changes in a relatively short and noisy record. This is illustrated by a clear Monte Carlo test of type I and II errors when a time-varying scale parameter is present.

One point that is not investigated and is a concern in these circumstances is the possibility that variations in variability arise purely by chance. A Monte Carlo plot demon-

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strating this analogously to Fig.4 would make the arguments more convincing. The wavelet analysis is announced, but not very well described; in particular no significance testing of any type is done and points outside the COI are shown in the plots. Finally, the link with precipitation patterns and in particular climate change, may be somewhat less direct than sometimes assumed in the text (though not in the conclusions).

## Major comments

1. In relatively short time series, detecting a (second-order) change in a noisy variable like the annual max discharge is always challenging. I very much appreciate the Monte Carlo approach of 4.1 in which the probability of making type I and type II errors is investigated from the different tests in a controlled environment. However, this MC is based on a model with a time-varying location parameter (and optionally varying scale parameter). I think it would be very good to show that the methods do not generate false positives in the case of a stationary distribution. Could you repeat the MC with constant scale parameter as a function of the time-dependence of the location parameter? In other words, can you show how much probability there is to obtain a time-varying location or scale parameter when the underlying model has no time-varying scale parameter, as a function of the strength of the time-dependence of the location parameter? Gershunov et al (J.Clim, 2001) and van Oldenborgh and Burgers (GRL, 2005) did this with the another noisy statistic and found that it was very hard to detect any significant variability.
2. The wavelet diagrams are discussed very summarily. In particular, no significance testing of any kind is done and points outside the cone of influence are shown in Fig.7. The results of a MC test of a stationary time series could be extended to do significance testing of the results of the wavelet analysis. Alternatively, the changes in a simple running variance can easily be tested against

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a null hypothesis of a stationary distribution (and always never show significant deviations in my experience).

3. The authors often make direct connections between the annual maximum runoff and precipitation changes in the area. However, other factors may be important as well: changes in land usage, water management, dam construction, etc. Can you make an estimate how much these have influenced the floods of the Mekong?

#### Minor comments

1. p.6693 'global climate models claim that climate change would drive higher precipitation and river discharge.' Only higher extremes in most areas, the mean precipitation response varies greatly by region.
2. p.6693 I am aware of several publications that discuss the effect of changes in variance have on extreme run-off, one example is Leander, R., T.A. Buishand, B.J.J.M. van den Hurk en M.J.M. de Wit, Estimated changes in flood quantiles of the river Meuse from resampling of regional climate model output. J. Hydrol., 2008, 351, 331-343, doi:10.1016/j.jhydrol.2007.12.020.
3. p.6695 Are the discharge data publicly available? If so, please mention the web site. If not, please mention this.
4. p.6695 Please show clear graphs of the annual maximum discharge series at this point, to give the reader an impression of the data.
5. p.6696 'but not generating much runoff due to flat topography' This is only true if one only considers the monsoon season, the annual sum of precipitation in this area is comparable to the precipitation in the highlands further upstream.

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6. p.6704 ‘the hypothesis of a strengthening Southwest monsoon.’ Is this hypothesis based on observations up to now, or climate model projections? Looking at a few observational datasets, I cannot see few significant trends in the July–September precipitation over the eastern highlands in the GPCP v2.1 dataset (1979–2008), the CRU TS 3 dataset 1970–2007 or the GPCP V4 dataset 1970–2007.

With regard to climate model projections, unfortunately the IPCC 4AR report only shows June–August averages that are not very useful in monsoon areas. Looking at the raw GCM output from PCMDI, most models only show moderate increases in precipitation in the Mekong basin region, on average less than 10% in 2100. One would not expect these to be detectable now. I do not have RCM output for that region handy, but in other regions changes in mean precipitation closely match those of the driving GCMs.

Of course, it may well be that the *average* intensity changes little but the *extremes* increase, which may be more relevant to the annual max discharge, but that is not the statement that is made here.

7. p.6706 ‘when the probability of an extreme flood starts increasing until the end of the century by 0.05’. This is under the assumption that the variability may be described well by a second-order polynomial. Under other (more physical) assumptions, such as a periodic component rather than a quadratic one, this number will be different. The same holds for other conclusions: the increase in the 20-year return period will have a different shape, maybe not monotonically increasing, if another assumption of the time-dependence of the shape is made. This dependence on the functional assumption should be mentioned.

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