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# *Interactive comment on* "Analysis and Modelling of a 9.3 kyr Palaeoflood Record: Correlations, Clustering and Cycles" *by* Annette Witt et al.

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Summary: The authors analyze an impressive record of paleo floods, for clustering and long term autocorrelation of events at different temporal aggregation levels. To this end they use the presence of gravel enriched strata (detrital layers) as indicator for channelized inflow due to a flood into the lake. This seems plausible as those events might be associated with bedload transport and sedimentation into a reconstructed paleo lake in the Italian Alps. Data were collected at on sediment outcrop yielding a time series of nearly 10 000 y including proxies of 771 flood events.

The authors compare the histogram and the autocorrelation function of the data at different temporal aggregation levels of years, decades and centuries using a Poisson process as a Null model and found clear autocorrelations and thus memory at among



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Discussion paper

flood intensities within decades and centuries. They relate furthermore the average inter flood periods in the data set again to the Poission process as Null model. Last not least they propose and successfully test a stochastical model to simulate paleo flood time series based on the superposition of fractional Gaussian noise with a long term memory component.

Evaluation: The study deals with a highly interesting topic and is based on a sound data set. The presented results are very interesting and partly reveal long term memory at the decadal and centennial resolution, and suggest that floods cluster in time and following a Weibull distribution. The proposed study is hence without doubt very much worth to be published in HESS. Yet I think that the particularly the manuscript needs to be restructured and streamlined and parts of the presented analysis net a more critical reflection. I thus recommend the author should revise their study addressing the following points.

Main Points: - The presentation of the manuscript is in many parts a little too wordy. E.g. there is no need to explain the concept of correlation in such a depth in the intro, as the auto correlation within a time series is well known. Unfortunately the authors mix the presentation of the statistical methods and results, this makes the manuscript difficult to follow and to evaluate the partly very interesting findings. I suggest to rearrange the presentation in a more old school manner and to present methods, results and discussion of those in separate sections.

- I wonder why the authors do not employ variograms/semivariances to estimate the spatial correlation time. This will better separate the un-correlated from the correlated variability in their records. In this context I wonder, how much of the increase in correlation times at the hifher aggregation levels may be attributed to well known scaling effects arising form to the aggregation process itself. The range of variogram estimated from data points increased when these are aggregated to blocks (or time intervals here) while nugget increases and sill decreases – this is well known from variogram regularization. This effect could be easily determined using data from your Poisson null model.

- I appreciate that one prefers the use of power law functions with infinite correlation length – but what is the physical meaning of this?

Minor points: - The authors use the presence of gravel enriched strata as indicator for channelized inflow due to a flood into the lake. This seems plausible as those events might be associated with bedload transport and sedimentation into the lake. However, there is no linear relation between flow velocity and bed load transport capacity. The literature is full of empirical formulas for this. This implies that the thickness of these strata is not linearly related to pealk discharge (flow velocities). The authors might consider this as an additional argument against the use of layer thickness as proxy for flood peak discharge.

- Why not showing a long time series of annual flood maxima, they also exhibit clustering of extremes and long time periods – this example is maybe closer to the object of desire?

- Could you also infer on clustering of intensities above a threshold using indicator auto correlations?

- I appreciate the authors effort to provide a reproducible paper, but the explanation of the Poisson process is too detailed, this is text book knowledge. The parameter lambda is the mean value of floods / time interval, which depends on the aggregation level. As far as I know the Poisson process produces cluster data, if lambda is larger than 1?

- Page 9 line 5: In case the flood do always occur in the first three years of the decade the average inter event period is not 1 year but, 2/3 *1 + 1/3*7= 3 years?

Best regards,

Erwin Zehe

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