**Reply to Reviewer 1 comments**

*Manuscript number: hess-2012-342-discussions*
*Title of the manuscript: On the nature of rainfall intermittency as revealed by different metrics and sampling approaches.*
*Authors: G. Mascaro, R. Deidda and M. Hellies.*

---

## Reply to Reviewer 1

First of all, we thank Reviewer 1 for the comments on our manuscript. In the following, the comments raised by Reviewer 1 are split into parts and copied in bold fonts to facilitate understanding of our answers.

After describing the paper summary and its main contribution, Reviewer 1 provides the following comment on technical soundness, organization and style.

**My only concern is the use of the gradient amplitude method (introduced by Tessier et al., 1993), used in Section 4.2 to obtain an intermittency exponent. Several studies (Veneziano and Iacobellis, 1999; Veneziano and Langousis, 2010; Neuman 2010a,b; 2012; Guadagnini and Neuman, 2011) have shown that the ratio in equation (6) does not scale and, therefore, the exponent $\mu_2$ in equation (6) depends on the temporal scale $\tau$. Since the authors do not use $\mu_2$ to study the scaling properties of rainfall, but rather to infer how the variance of the temporal process depends on the amplitude of rainfall fluctuations [i.e. by comparing results obtained for the binary (BS) and full (FS) series at the same scale of averaging], their analysis, results and conclusions are not affected by lack of scaling of the ratio in equation (6). However, I find it important that the authors mention the lack of scaling introduced by the gradient amplitude method, refer to the aforementioned studies, and explain that the validity of their results is not affected by lack of scaling of the measure, since they do not compare results from different temporal scales. Alternatively, the authors may eliminate the gradient amplitude method from their analysis. The final decision is left to them, and the editor in charge.**

We thank Reviewer 1 for pointing out the issues related to the use and interpretation of the intermittency exponent and, in general, of techniques based on gradients. As correctly highlighted by Reviewer 1, we adopted this metric to compare the intermittency of the FS and BS series, rather than to identify evidence of scaling and multifractality. To avoid any misunderstanding, we explicitly clarified this aspect in lines 247-251 of the revised manuscript.

Next, Reviewer 1 reports the following general comment.

**I do not understand why smaller values of spectral exponents indicate longer memory; lines 2-3. Actually, for Gaussian processes, larger spectral exponents indicate longer memory. Since the authors do not consider such processes, my opinion is that spectral exponents indicate how the overall variability of the process is distributed to different scales. That said, starting from the smallest scale, high spectral exponents indicate fast decrease of the variability of the process with increasing scale, whereas smaller values indicate a less intense decrease. I suggest the authors avoid relating the memory of the process with its spectrum, and stay with more profound arguments on how the variability of the process decreases with increasing temporal scale. This applies, also, to other parts of the manuscript where spectral exponents are linked to the memory of the process (e.g. page 9983, lines: 21-23; page 9986, lines: 9-19).**

**Reply to Reviewer 1 comments**

*Manuscript number: hess-2012-342-discussions*
*Title of the manuscript: On the nature of rainfall intermittency as revealed by different metrics and sampling approaches.*
*Authors: G. Mascaro, R. Deidda and M. Hellies.*

---

We have adopted the word "memory" in the interpretation of the spectral exponents to characterize how the energy and variability is conserved (or decays) with the time scale: we attributed more or longer memory to a signal characterized by a slower decay of the energy (lower spectral exponent). A similar interpretation was also provided in a recent paper by Molini et al. (2009). As suggested by Reviewer 1, to avoid possible misunderstandings, in the revised manuscript, we eliminated any reference to the concept of memory and directly provided comments on the slower or faster decay of the energy as a function of the time scales, with reference to the physical interpretation provided by Purdy et al. (2001). The modified parts in the revised manuscript version are in lines 4 (we eliminated reference to memory), 308 to 314 (we modified the interpretation), 381 to 382 (we modified the interpretation), 444 to 445 (we eliminated reference to memory).

After the general comments, Reviewer 1 reports a total of 77 specific comments. In the following, we provide answers to some of these specific comments. The others (the great majority) simply consist of minor changes to small parts of sentences, which we entirely incorporated in the revised version of the manuscript. We thank Reviewer 1 for these suggestions that have helped improving the readability and the English grammar of the manuscript.

**Specific comment 41: Please indicate the stations with IDs 1, 42, 6 and 319 (e.g. with arrows) in Figure 1.**
We modified Fig. 1 by indicating the gauges with IDs 1, 6, 42 and 319 with triangles. We added the ID close to their location only in Fig. 1b, because Fig. 1a was already too busy.

**Specific comment 45: Change: more To: longer**
We modified the entire sentence according to what Reviewer 1 has suggested in his general comment.

**Specific comment 48: A probable reason for the observed inconsistency is that, at scales larger than several days, the rainfall process does not exhibit a multiplicative structure.**
We incorporated this suggestion in the text of the revised manuscript (lines 333-334).

**Specific comment 51: I think that the increase of $\alpha^{BS}$ with elevation is very small and within the range of statistical variability. The increase of $\alpha^{FS}$ is statistically significant and, according to my opinion, it shows faster decrease of the variability of the rainfall process with increasing scale, as the elevation increases. I suggest the authors avoid referring to the memory of the process; see General comment 1.**
We modified the interpretation of the relation between spectral exponents and elevation, following the physical interpretation provided by Purdy et al. (2001).

**Specific comment 56: Please specify how the obtained results depend on $\Delta t^*$. Also, please include a brief description of your findings (no figure is required).**
In the original manuscript we erroneously referred to "storm duration" rather than to "cell life" duration. The original sentence:

**Reply to Reviewer 1 comments**

*Manuscript number: hess-2012-342-discussions*
*Title of the manuscript: On the nature of rainfall intermittency as revealed by different metrics and sampling approaches.*
*Authors: G. Mascaro, R. Deidda and M. Hellies.*

---

*"From a physical point of view, the duration $\Delta t$* is associated with the typical storm duration in the study region. In the Mediterranean climate here analyzed, we fixed $\Delta t^*$ = 15 min"* has been now modified as: "*From a physical point of view, the duration $\Delta t^*$ is associated with the typical cell life duration, which can range from ten minutes to more than half an hour. We tested several $\Delta t^*$ values within this range, obtaining similar results in terms of scaling regimes and metrics. In this work, we assumed $\Delta t^*$=15 min as this is physically consistent with the rainfall characteristics in the study area".* (lines 506-510 in the revised manuscript version).

**Specific comment 60: Please add contour lines, and indicate stations with IDs 1, 42, 6 and 319 (e.g. with arrows).**
We indicated the gauges with IDs 1, 6, 42 and 319 with triangles. We decided not to add contour lines on top of the DEM and the precipitation map, because these would introduce too many details in the figure.

## References

Molini, A., Katul, G. G., and Porporato, A.: Revisiting rainfall clustrering and intermittency across different climatic regimes, Water Resources Research, 45, 2009.

Purdy, J. C., Harris, D., Austin, G. L., Seed, A. W., and Gray, W.: A case study of orographic rainfall processes incorporating multiscaling characterization techniques, J. Geophys. Res., 106(D8), 7837–7845, 2001.