

## ***Interactive comment on “Droughts and floods over the upper catchment of the Blue Nile and their connections to the timing of El Niño and La Niña Events” by M. A. H. Zaroug et al.***

**Anonymous Referee #2**

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Review of “Droughts and floods over the upper catchment of the Blue Nile and their connections to the timing of El Niño and La Niña Events” by Modathir Zaroug and coauthors.

### Summary

The manuscript presents an evaluation of low and high discharge conditions (drought and floods) over the upper catchment of the Blue Nile Basin in their connections to the timing of El Niño and La Niña Events. This is an observational study that found several interesting relations, e.g. high probability of flood events when an El Niño event

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is followed by a La Niña event. However, the authors do not provide further insight to the mechanisms responsible for these findings. Therefore, I recommend major revisions, listed below, in particular: (i) clarifying the limitations of the current analysis, and (ii) providing some suggestions for future work that could lead to a better understanding of the role of the Pacific sea surface temperatures on the rainfall/discharge anomalies in the Blue Nile Basin.

### Comments

Fig 6 results: I suggest replacing the panels of Figure 6 by scatter plots of Niño 3.4 versus discharge anomalies for each of the seasons. The time series only show the period 1982–2009, while there is data since 1965 to 2012. Along with the scatter plots, the values of the coefficient of determination (or R squared) could be also calculated for the linear fit between Niño 3.4 and discharge anomalies in each season. This would quantify the relation between the SST anomalies in the discharge in the different seasons, and support the author’s discussion in Page 10977 (Lines 3 to 14). Start date of El Niño/ La Niña in ASO : Considering that the main rainy season extends from June to September, would it be expected that when El Niño / La Niña starts later in the year, during ASO, the impact in discharge to be reduced ? The authors could discuss this point when analyzing the results in table 1 and 2. Furthermore, the El Niño and La Niña events starting in ASO tend to have shorter lengths when compared with the other starting dates. The authors should also discuss this in more detail. Was this documented before?

Pag 10978, Line 15–18: “Therefore, in general, when La Niña started in AMJ, JJA and JAS, 67% of the times there was a flood or extreme flood, showing that the rainfall and the monsoon in this catchment is sensitive to AMJ, JJA and JAS SST in the Pacific Ocean.” How was the value of 67% calculated? It is not clear how the conditional probability was calculated. From my understanding, the authors want to calculate the conditional probability of extreme flood or flood in the first year (P(F)) given a La Niña event (that started in AMJ, JJA or JAS) (P(La)):  $P(F|La) = P(F \cap La) / P(La) = 4$  (ex-

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treme flood or flood events during the first year of a La Nina event) / 6 (number of la Nina events) = 67%. If this is the case, the authors should clarify the calculation, and highlight the reduced number of samples to calculate this conditional probability.

Following the previous comment, the relation between flood events and El Nino followed by La Nina years (in table 3), is based on very few cases, and the authors do not provide any other evidence of such a relation. Is there some known relation in terms of strength of El Nino when followed by La Nina? Other anomalies in SST outside of the Pacific? Maybe in the Indian Ocean? The discussion of these results should include the limitations of the reduced number of cases, and provide some other evidence of those relations. This last point might be out of the scope of the manuscript, but the authors could at least include in the conclusions the potential for future work to investigate these relationships (for example suggesting configurations for idealized experiments with a general circulation model).

To support the discussion of Figure 7, the correlations between the discharge anomalies and the precipitation anomalies should be added (e.g. in the Figure legend) Figure 9 could be removed, and the critical value for 95% significance of the correlations added in Figure 8 has an horizontal line.

Pag 10972, Line 5: replace: "to occurrence of floods and droughts in rainfall and river flow over the Nile basin" by: "to occurrence of meteorological and hydrological droughts in the Nile basin".

Pag 10972, Line 23: replace: "and contributes about 67% to the main Nile discharge." By: "contributing to about 67% of the main Nile discharge".

Pag 10973, Line 21: "which has a return period of about 4 yr": I recommend adding: " (varying from 2 to 7 years)

Pag 10974, Line 17/18: Since most of the analysis is done on river discharge, I suggest clarifying at this point that flood and drought in the context of this paper refer to high

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and low flows, respectively.

Pag. 10976, Line 24: Replace: "and in line with the classification" by: "as well as with the classification"

Pag 10990, Fig. 4 caption: replace "2994" by "2004".

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