Thank you for all the comments and questions regarding to our submission to HESS: Hydrological functioning of West-African inland valleys explored with a critical zone model". Many thanks to the four reviewers who raised relevant questions that we hope to address in this final response. We will mainly gather previous replies written in the debate phase and add our suggestions for changes in the manuscript.

RV#2

It is not clear from the manuscript how the slopes of the tilted-v catchment (4% and 2% in Y- and X-directions, respectively) are representative of the real topography? This is important because the authors are using ParFlow, which is a 3D variably saturated surface water/groundwater flow model. The water flow in this model is dominated by topography. The authors presented the comparisons between observations and simulation results. How much does the representation of the topographic slopes contribute to the differences between the observed and simulated fluxes? Moreover, without a comprehensive representation of the real topography or justification of the considered topographic slopes, how can this be assured that the hydrological processes of the simulated tilted-v are representative of those of the actual catchment? Reasonable agreements between the observations and simulation results do not answer all these questions. Is it worthwhile to consider the real topography (which is very possible as ParFlow-CLM is a distributed model) of the area rather than a tilted-v catchment with arbitrary slopes? These issues should be clarified in the manuscript before publication.

=> Both two reviewers (#1 & #2) had relevant interrogations about the impact of topography on the generalization of the results presented in this study.

Although we specified that the V-shaped (virtual) catchment slopes correspond to the actual slopes of the reference inland valley of Nalohou (P.9 L. 14: "(mean N-S and E-W slopes correspond to those imposed on the virtual V-shaped catchment)"), it is clear that more details should be provided.

Nalohou catchment has been surveyed with double-difference GPS campaigns to provide accurate topography at 5m resolution. Local mean N-S & E-W slopes come from such dataset.

At the Upper Oueme catchment scale (14 000 km2), comprising many more inland valleys (Giertz et al., 2012), a quick slope analysis from 3" (about 90m) Hydrosheds DEM provided an average slope of 2.6 %. On nearby Togo in similar geomorpholigical context (Région centrale, 13000 km2), Runge (1991), noted that 80% of surface have slopes comprised in the range 1.7 – 5.2 %. They further identified inland valley to develop preferentially in the range 3.0 – 4.4 % along the steepest axis.
The transverse axis (X in our case) ranges from 1.7 to 3.5% and the longitudinal axis (Y) from 3.5 to 5.2%. These numbers are very close to our virtual catchment (X: 2% Y: 4%).

Despite this relevance with respect to other (including larger scales) inland valleys, we wanted to check the impact of slopes on simulation results (budgets, and agreement to observations, as suggested by reviewers. We have not had the time to conduct the virtual experiments so far but could do so if needed.

going further than our previous reply, we ran two more simulations using the reference case, and multiplying the slopes by a factor 2 and a factor 0.5. The results are given below in terms of mean + standard deviations over the 6 years period for the different budget components. Other test cases are presented for comparison.

	ET (mm)	Q (mm)	S (mm)
reference	839 ± 64	454 ± 151	8 ± 26
No Inland valley	830 ± 64	463 ± 153	8 ± 24
trees	944 ± 53	361 ± 144	-5 ± 54
herb	791 ± 72	500 ± 151	10 ± 17
saprolite	793 ± 60	495 ± 153	13 ± 36
mixed	816 ± 62	475 ± 154	10 ± 28
Slope ref x 0.5	**933 ± 62**	**354 ± 154**	**14 ± 28**
Slope ref x 2	**773 ± 64**	**526 ± 157**	**1 ± 21**

Table 1: summary of the annual average and standard deviation for the 6 simulated years and for each budget component. Reference case with slopes multiplied by 0.5 and 2 are also shown.

There is an insignificant impact on the interannual variability (standard deviation), but a significant impact on yearly averages. The slope values taken in this short experiment are extreme cases as compared to the regional topography where inland-valleys are found (see previous comment). Yet their impact is comparable to the impact of vegetation distribution (trees case ~ slope ref x0.5 ; herb case ~ slope ref x2). Lower slopes (resp. higher) decrease (resp. increase) lateral transfers to the benefit (resp. cost) of evapotranspiration. This short analysis can be added to the paper, together with the references given in our previous reply to comments.

The goal of the paper is not to reproduce absolutely the behavior of our benchmark catchment say, by using the real topography, as we want to derive the controlling factors of inland valley critical zone systems -through virtual experiments- among factors that are either susceptible to evolve (land cover), that characterize inland valleys (thalweg clay lens) or are still largely unknown (subsurface lithology). To this respect, slopes are not unknowns nor susceptible to evolve much (as land cover which have been observed to change significantly, and are also projected to do so) and are not targets of this study. However, catchment slopes may significantly impact the water budgets as shown by these two experiments, and impact our ability to generalize the inland valley functioning based on this study only.

Modifications in the manuscript:

P5. L.6. add a section: 2.1.2: Topography:
At the Upper Oueme catchment scale (14 000 km2, which includes the Nalohou area), comprising many inland valleys (Giertz et al., 2012), a slope analysis from 3” (about 90m) Hydrosheds DEM provided an average slope of 2.6 %. On nearby Togo in similar geomorphological context (Région centrale, 13000 km2), Runge (1991), noted that 80% of surface have slopes comprised in the range 1.7 – 5.2 %. They further identified inland valleys to develop preferentially in the range 3.0 – 4.4 % along the steepest axis. The transverse axis ranges from 1.7 to 3.5% and the longitudinal axis from 3.5 to 5.2%. For the specific Nalohou catchment, mean longitudinal slope (N-S) is 4% and mean transverse (E-W) absolute slope is 2%, according to a 5m lateral resolution DEM derived from DGPS survey, as described in Hector et al., (2013).

P11. L24. New paragraph:
Furthermore, as topography drives lateral flow, we conducted two more experiments on the impact of slopes, using the reference case, and multiplying the slopes by a factor 2 and a factor 0.5. These simplified experiments allow to extract the effect of extreme topography range found in this environment (Runge, 1991).

P 15. L 6. New paragraph:
For the simplified slope experiments, there is an insignificant impact on the interannual variability (standard deviation), but a significant impact on yearly averages. The slope values taken in this short experiment are extreme cases as compared to the regional topography where inland-valleys are found. Yet their impact is comparable to the impact of vegetation distribution (trees case ~ slope ref x0.5 ; herb case ~ slope ref x2). Lower slopes (resp. higher) decrease (resp. increase) lateral transfers to the benefit (resp. cost) of evapotranspiration.

Modification in Table 6:

	ET (mm)	Q (mm)	S (mm)
reference	839 ± 64	454 ± 151	8 ± 26
No Inland valley	830 ± 64	463 ± 153	8 ± 24
trees	944 ± 53	361 ± 144	-5 ± 54
herb	791 ± 72	500 ± 151	10 ± 17
saprolite	793 ± 60	495 ± 153	13 ± 36
mixed	816 ± 62	475 ± 154	10 ± 28
Slope ref x 0.5	**933 ± 62**	**354 ± 154**	**14 ± 28**
Slope ref x 2	**773 ± 64**	**526 ± 157**	**1 ± 21**

P.17. L7. New paragraph:

The goal of the paper is to derive the controlling factors of inland valley critical zone systems -through virtual experiments- among factors that are either susceptible to evolve (land cover), that characterize inland valleys (thalweg clay lens) or are still largely unknown (subsurface lithology). To this respect, slopes and topographic effects are not unknowns nor susceptible to evolve much (as land cover which have been observed to change significantly, and are also projected to do so) and are not targets of this study. However, catchment slopes may significantly impact the water budgets as shown by the two experiments (Table 6), and impact our ability to generalize the inland valley functioning based on this study only.

Added references

Giertz, S., Steup, G. and Schönbrodt, S.: Use and constraints on the use of inland valley ecosystems in central Benin: results from an inland valley survey, Erdkunde, 66(3), 239–253, 2012.

Runge , J. (1991): Geomorphological depressions (Bas-fonds) and present-day erosion processes on the planation surface of Central-Togo/Westafrica. In: Erdkunde 45, 52-65. DOI: 10.3112/erdkunde.1991.01.05