Dear Reviewer G. Thirel, thank you for your review and constructive comments. I hope that we answer all your remarks.

Reviewer: "The paper by Andrianaki et al. deals with a topic of interest for HESS readers: the modelling of runoff in a glacierised catchments and projections of its evolution. The manuscript reads easily and is concise; I would like to thank the authors for that, as it is often not the case and readers are burdened with loads of not so useful information in many papers. That said, I feel that there is room for improvement before the paper reads as a scientific paper. Here are my **main remarks**.

1) The main criticism is that I failed to identify clearly what the readers could bring home from this manuscript. Definitely not a new methodology, as the SWAT model is basically used as is, the sensitivity test is not detailed and the calibration and climate change exercises are classical. In my opinion, results are also not so remarkable. It is very interesting to see the validation exercise on a different period and then on a different catchment, but in the end we have results about one catchment and the calibration period is very short. As aconsequence, we could wonder if we have the right answer for the right reason or not. I find it very difficult to extrapolate anything from results on this catchment for further works.

If the main additional value of the paper is the fact that SWAT works for this area, then this should be better highlighted and put into perspective with relevant literature. This reflects on the objectives of the study, which are barely presented in the paper and makes it look like an application of the model rather than an actual research work. Only lines 51-52 give some elements on the interest of this work. Consistently, the conclusions only briefly highlight one novelty of the study (L. 354). In my opinion, the abstract, the introduction and the conclusions should be clear about the novelty of this work."

Authors: You are right that probably we didn't explain clearly enough the objectives of this study.

One of the challenges that researchers in hydrological modelling face is the lack of data for model setup and calibration in ungauged watersheds. Especially in high mountainous regions a big part of the watersheds is ungauged. In the last years, there is an increasing interest in applying SWAT on snow-dominated (Grousson et al., 2015) and glacierised watersheds (Omani et al., 2017; Rahman et al., 2013). However, its transponsability and its application for the simulation of runoff in high altitude ungauged watersheds hasn't been tested yet.

Our study area is characterised by extreme climatic conditions, high altitude and steep slopes. Here, we have a quite unique situation; a small well gauged watershed monitored through the CZO projects, which is part of a larger watershed, for which we have hydrological data thanks to its use by the hydroelectric power plant. This gives us the opportunity to verify the applicability of SWAT under extreme conditions and its transferability on spatial and temporal scale, by using the small Damma watershed (10.5 km^2) as the gauged watershed and the greater area feeding the Göscheneralpsee reservoir

(100 km^2) as an ungauged catchment. We used the approach of spatial proximity and transferred the calibrated parameters of the model from the donor watershed, which in this case is the Damma glacier watershed, to the greater area. By comparing the model results with the existing measurements provided by the managers of the reservoir, we were able to test whether the model can eventually be transposed and applied efficiently on a different spatial scale, and where its advantages and disadvantages lie.

Finally, we conducted the climate change simulations, not to do another set of classical climate change exercises, but to investigate whether SWAT can be further transposed on a temporal scale, since we could compare our findings with those of a previous study for the same area, which used two other hydrological models with different characteristics, PREVAH and Alpine 3D (Kobierska et al., 2013).

In addition, the Damma Glacier watershed is a Critical Zone Observatory part of the Critical Zone Exploration Network, a global network of field sites investigating the physical, chemical and biological processes of the critical zone (www.czen.org). Because CZOs are well studied sites and usually have long records of data, we wanted to show how they can be used in water management, since they could serve as parameter donor catchments.

Our results presented in the manuscript, as well as further analysis suggested by the Editor (please see our response to the Editor), showed that SWAT can predict satisfactorily runoff after being upscaled and applied in different scales, even under alpine conditions. This approach, which doesn't require complex regionalisation methods, can be quite useful in water management and climate change studies, considering the fact that SWAT is a widely used model, even in large scale simulations (Pagliero et al, 2014). The performance of the model could be further improved if different rates of glaciermelt and snowmelt had been applied.

In the revised manuscript we have rewritten a big part of the abstract and introduction, adding relevant literature, discussing all the above with more detail and explaining the objectives in a clear way. In the conclusions paragraph we discussed in a more critical and constructive way about the performance of the model and how it could be improved and the conclusions from the comparison between the models and the climate change study.

Reviewer:"2) It is, if I'm not wrong, never clearly stated that calibration of SWAT is done compared todischarge observations only. Calibration is mentioned many times (abstract, end of introduction, section 3.3) but the used observation is not given. SWAT is physically based and snow observations are definitely an additional value to models calibration in snowy areas, so it is legitimate to wonder if the authors used any kind of snow data here."

Authors: The model was calibrated against measured runoff of the Damma watershed, which is described in paragraph 3.2.4. Comparison of the measured runoff with the results of the model before and after the calibration is given in Fig.3, page 16. Small corrections were made in the text to make this clearer.

Data for the evolution of the glacier were available for the whole area (paragraph 3.2.5) provided by Paul et al., 2007 and snow density and snow depth measurements were available for the Damma watershed only. We used these data to define the initial glacier storage for each elevation band of each subbasin. We didn't use it for the calibration of the model because we didn't think it would add to the purpose of the study at this stage.

Reviewer: "3) The calibration set up is unclear and at some point, flawed to me. First, we don't know exactly what the objective function is: authors introduce NS and R^2 but they don't specify how they used them: through a composite criterion? With a Pareto front? Then, the use of NS in snowfed basins is not advised. Indeed, this criterion relates the performance to the mean observed discharge, which is a bad predictor in such a seasonally variable environment (see Schaefli and Gupta (2007)). Italso underestimates discharge variability.

Finally, we don't know how the parameters from the small basin are transferred to the larger one. Are some of these parameters time or scale dependent? It is just said that they are adjusted.

4) The structure of section 4.1 is not easy to follow. Some kind of sensitivity test is done to identify which parameters to calibrate. I failed to understand if it was done by the authors, and if yes I don't understand why it is mentioned only in the third paragraph, so after talking about the values of the calibrated parameters. Also, the word "set" is often used to refer to parameters; as it is unclear what is meant since both a manual calibration and an automatic one are mentioned, I got a bit lost.

In addition, authors seem to infer that Table 1 shows the results of a sensitivity test. What I rather see here is how different the calibrated values are from the default ones, some of them being unrealistic maybe (I don't know where they come from). L. 239: which ones are the least sensitive ones?"

Authors: Initially we conducted the calibration manually because we wanted to identify the parameters that really influence the hydrology of the site. For the manual calibration both NS and R^2 were checked but again manually. After the manual calibration we used SWAT-CUP software and the program SUFI-2 (Sequential Uncertainty Fitting version 2) (Abbaspour et al., 2007) for the automated calibration (fine tuning) and the sensitivity analysis. The manual calibration helped us in defining whichparameters will be calibrated by SUFI-2 as well as their range. For example, because our site is above the tree line,evapotranspiration is not significant, and ET related parameters were left to their default values. For the SUFI-2NS objective function was chosen because it was the criterion available in SUFI-2, which is most commonly used in similar studies.

Table 1 doesn't show the sensitivity test. It shows the default and calibrated values of the parameters that were introduced into SUFI2 and were calibrated. The sensitivity test showed that these parameters are indeed the most sensitive ones. Some of these values are very different from the default ones probably because our watershed is characterised by extreme conditions. For example, due to its topography (very steep slopes) and geology Damma watershed has a very fast response which led to the high value of ALPHA_BF and the low value of GW_DELAY.

The input data of SWAT include topography, landuse and soil maps and during the initial delineation of the watershed many parameters are given a value based on these data. This a priori parameterisation assisted the use of the model for the bigger area. Then the calibrated parameters were applied to the bigger area with the same values that resulted from the calibration without any regionalisation procedure or another adjustment. We decided to do that because the Damma watershed and the greater area are very similar.

After receiving your review, we calculated the Benchmark Efficiency according to Schaefli and Gupta (2007) and for the period 2009-2011 the BE value is 0.22 and for 2012-2015 the BE is 0.25. The calculation of BE is included now in the revised text. Furthermore, more detail was added in the calibration paragraph to make it better understood.

Reviewer:"5) The actual setup of this whole study is not justified by the authors. Why is the modelcalibrated on the small basin that has few data and validated on the large basin with a lot ofdata rather than the opposite?"

Authors: As mentioned above, in this study we have a quite unique situation; a small well gauged watershed monitored through the CZO projects, which is part of a larger watershed, for which we have hydrological data thanks to its use by the hydroelectric power plant. This way we wanted to check the application of SWAT in high altitude basins and its upscaling to ungauged catchments in alpine conditions. Since we already had the climate change study with Alpine 3D and PREVAH for the bigger area, we calibrated the model for the small watershed and transferred it to the bigger. In the revised text we give more detail to explain this further.

Reviewer: "6) L. 304: I thought that the black (reference) curve in Fig. 7 should be the same as the SWATcurve in Fig. 6, but it does not seem so. Did I get something wrong? The resolution of Fig. 7could be improved, it is more difficult to read than Fig. 6."

Authors: You are right. There is an error in the text, line 284. In Fig. 6 the interannual average is for the period 1997-2010 and not 1981–2010 mentioned in the text. The caption of Fig.6 is correct. In Fig. 7 the reference period is 1981-2010. Figures 6 and Figures 7 were redone.

Reviewer: “7) L. 317: the authors state that the volume of the glacier reduces to half in 2070. I wonder how this is considered in the SWAT model. Indeed, I expect that the initialconditions of the model (due to the Delta method used for producing the climate projections a continuoushydrological projection cannot be done) had to be adjusted. How was that done? Also,please precise who estimated this reduction (authors? Literature?).”

Authors: We have data for the evolution of the glacier for both future periods provided by Paul et al. (2007). Based on this, the initial glacier storage was calculated, and the SWAT was setup for each climate change scenario. According to the data of the evolution of the glaciers the glacier volume will be reduced in our site approximately to half by 2070. The sentence was rephrased to explain this better.

Minor remarks:

Reviewer: “Title: The title is not very sexy… Also CZO is an acronym, is it well known enough to be used in a title?”
Authors: Indeed, the title is not very sexy. Another title could be “Assessment of the transferability of SWAT at an alpineglacierised catchment”. CZO is removed from the title anyway.

Reviewer:“L. 30, 32 and many other places: a space is missing after the semi-colon.”
Authors: Corrected

Reviewer: “L. 31: I think that the lack of observed data of sufficient quality could also be mentioned.”
Authors: Done

Reviewer: “Section 2: what is the surface area of the small watershed? It is only given for the larger one.”
Authors: The area of the small watershed is 10.5 km^2

Reviewer: “L. 60: after “(Fig. 1)” I think that “is” is missing.”
Authors: Done

Reviewer: “L. 62: inconsistent (lack of) space between number and unit.”
Authors: Corrected

Reviewer:“L. 69, 74…: why is “et al.” suddenly in italics?”
Authors: Corrected

Reviewer: “L. 77: I would add a comma after “interface””

Authors: Corrected

Reviewer:"L. 135: strange punctuation after "Climate change scenarios"
Authors: Corrected

Reviewer:L. 149-150: are the parentheses necessary around Delta P and Delta T? "(Bosshard et al. 2011)" should be "Bosshard et al. (2011)"
Authors: Corrected

Reviewer:L. 158: I would add "scenarios" after "SMHI"
Authors: Added

Reviewer:L. 164: if I got it right, Delta P close to 1 mean no change. Is it correct?
Authors: Yes

Reviewer:L. 172: "extenT"
Authors: Corrected

Reviewer:L. 211: what you have done is a proxy-basin sample test according to the well-known paper Klemes (1986). This is not done so often, I recommend citing this paper
Authors: You are right that our approach is similar to the proxy basin sample test suggested by Klemes (1986) and we added this paper in the introduction together with a short description of the test.

Reviewer:L. 220: "temperatureS"
Authors: Corrected

Reviewer:L. 225: I would add a comma after "September"
Authors: Corrected

Reviewer:L. 302: I also see a shift of the peak for the far future
Authors: The sentence in L.302 was deleted because it was not clear enough.

Reviewer:L. 320: "snow-fre"
Authors: Corrected

Reviewer:L. 323: using the future is a bit too categorical. There are some uncertainties in projections.
Authors: Some sentences were rephrased to emphasize that these are predictions.

Reviewer:L. 360: any ideas about these other uses? I think this is of interest for the readers.

Authors: This approach could be used in the simulation of runoff in high altitude ungauged catchments with limited data or in large scale simulations with SWAT. Big part of the paragraph was rephrased to explain this in a better way.

Reviewer: L. 428: Farinotti et al. (2012) is given twice. L. 471: Viviroli et al. (2004) has been published, please update L. 480: "SIMULATION1": what is this "1"?
Authors: Corrected

Reviewer:Table 1: space or no space between "mm" and "H2O"? In the caption, I would place "SWAT parameters" just after "sensitive"
Authors: Corrected

Reviewer: Fig. 1 and 2: scale and north direction are missing. I would skip "The Damma Glacier CZO" on top of Fig. 1.

Authors: Figures 1 and 2 were combined in one.

Reviewer: Fig. 3 and others: months are not given in English ("Dez"). I would also lie to see each time in the caption the catchment of interest and the period.
Authors: Sorry for not noticing about the months that are not in English. It is corrected. The captions were corrected to include catchment and period.

Reviewer:Fig. 5: panel (a) is too small for the long period given; it hides potential serious mismatches between simulation and observations.
Authors: We tried to apply a different colour scheme and it is slightly improved.

Reviewer: Fig. 6: is it 1981 as in the text or 1987? Is that an interannual mean? Please comment why SWAT underestimates low flows.
Authors: The caption is correct. The 1981 in the text was wrong but now is corrected. It is true that SWAT underestimates low flows and this discussion is added in the revised manuscript. The Damma glacier watershed is characterised by very steep slopes (even up to nearly 80 degrees) and runoff originates mainly from snowmelt, glacier melt and rainfall (Magnuson et al., 2012). Consequently, the watershed is characterised by very fast response, which in terms of the model parameters resulted on the high value of ALPHA_BF and the low value of the GW_Delay. On the other hand, the Göscheneralpsee feeding area is less steep on average and maybe the interactions between groundwater and surface runoff must be more significant than those of the Damma watershed. Furthermore, two out of the four watersheds of the greater area are drained into the reservoir through tunnels, which undoubtably influence the low flow measurements of the reservoir. These factors explain why the model, which is calibrated for the Damma watershed, doesn't simulate successfully the low flows of the greater area.

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