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**hess-2020-605**  
Responses to anonymous referee 1

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Dear Anonymous Reviewer 1,

thank you very much for reviewing our manuscript. We are very grateful for your comments and suggestions. In the following, we provide detailed responses to all your comments.

On behalf of all authors,

Sincerely,

Erwin Rottler

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# 1 General Comment

Scientific terms and abbreviations should be the same in figures, tables and the text. E.g. in Fig 5 the term "discharge" is used but in the text "streamflow". in Fig 6 and its captions is written "melt magnitude" but in table 2 and the text the abbreviation Smax14. In table 2 Smax14 is singular, in the text sometimes plural. In the figures, tables and their captions should be checked if the same terms are used as in the text. I suggest to give the explanation of abbreviations in the method chapter, in table 2 and in the captions of the figures (but there only in brackets).

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Thank you for pointing at this issue. We will harmonise the expressions including figures and tables throughout our manuscript.

## 2 Specific comments

### 2.1 Comment 1 - Data and Methods

The expression "sub-basin upstream gauge Basel" is quite complicate and, as I think, not necessary. I suggest to explain, that some of the investigated variables refer to the gauge and others to the basin. And then I would refer only to "gauge Basel" or "basin of gauge Basel"). Same for Cochem. Especially in the later chapters the long term of "sub-basin upstream gauge Basel" is a bit confusing.

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Yes, we also discussed this internally already. We agree that the expression "sub-basin upstream gauge [...]" is a bit bulky/cumbersome. We will make it shorter and concise in the revised version.

### 2.2 Comment 2 - Data and Methods

P7, Fig3: Misspelling in the last point (elevation and solid precipitation)

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Yes. You are right. We will correct this typing error.

### 2.3 Comment 3 - Data and Methods

P8, Table 2: the two last variables are not listed on P6, L11-L13. For me it is not clear what is meant with "melt elevation" especially when it comes to the units (see also Fig 6). For more clarity one could give the units in the table that also helps to understand if it is a value at a gauge or for a basin.

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Thank you for your comment. We will introduce all different variables by extending Tab. 2 with information on their units and scale (gauge or basin).

### 2.4 Comment 4 - Results

It would be helpful, if the figures would be described more systematically. Sometimes exact values are given, sometimes not. Sometimes the results for Basel are described first, sometimes those for Cochem. It would be less confusing for the reader, wenn the order would be always like in the figures.

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Yes, a recurring structure closer to the order within the figures can facilitate the reading of the manuscript. We will re-structure our text accordingly.

### 2.5 Comment 5 - Results

P8, L1: In my opinion the first two sentences contain already important results and therefore should be more precise and with more information. E.g. like this: "According to the model simulations the changes are largest at gauge Basel (Fig. 5a). Here, the median of discharge magnitude increases from 2500(?) m<sup>3</sup> /s in the historic period to 2700 (?) m<sup>3</sup> /s supposing a warming of 1.5 degree. Furthermore, the highest floods are higher than in the historic period. However, this increase in discharge is not linear with temperature rise....".

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Thank you for your observation. Yes, the first two sentences on page 8 are short, but contain important information already. We will rephrase them following you recommendations.

## 2.6 Comment 6 - Results

P8, L4: The results for Cochem and Cologne (Fig 5b and 5c) should be briefly mentioned already here (e.g. Cochem shows only very little increase of maximum discharge with increasing temperature).

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We will include information on gauges Cochem and Cologne here.

## 2.7 Comment 7 - Results

P8, L5: The figure reference is not correct. Should be Fig. 5d to 5f.

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We will add the correct reference here.

## 2.8 Comment 8 - Results

P8, L8: I see a signal of change for Cochem: annual maxima seems to be a bit earlier (probably due to less solid fraction in the Vosges as proved in fig 6) .

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Yes, there seems to be the tendency that with rising temperatures annual streamflow maxima observed at gauge Cochem more and more are restricted to winter (December to February). With rising temperatures fewer peaks seem to occur in spring. We will take a closer look into this during the revision.

## 2.9 Comment 9 - Results

P8, L13: Wrong word? "...runoff contribution of snowmelt of more the 20%..." should probably be "...runoff contribution of snowmelt of more than 20%...".

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Reviewer is right, it should be "more than". We will correct this.

## 2.10 Comment 10 - Results

P8, L15: Here, Smax14 is plural and in the sentence before singular.

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In the sentence before, we refer to the "median of Smax14" and later on we talk about all

Smax14 values. We will scan through our manuscript to make sure that there are no mix ups between singular and plural with regard to the abbreviations.

### **2.11 Comment 11 - Results**

P8, L16: "solid Pmax5" is probably wrong, "total Pmax5" is probably meant as shown in the Figure and als logically (solid Pmax5 decreases with temperature rise).

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Thank you for pointing at this. Yes, it should be "total Pmax5". We will correct this.

### **2.12 Comment 12 - Results**

P8, L22: Value of solid fraction should also be given for the historic period (80%), so that the reader do not have to look for it in the figure.

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We will include these values to the corresponding paragraph.

### **2.13 Comment 13 - Results**

P11, L1: In think the information on highest ETmax14 is not relevant for the purpose of this study that is flood seasonality. This sentence should be deleted.

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Yes, the exact number of the ETmax14 seems unnecessary here. In our attempt to establish recurring structures in the individual section, well will also re-phrase this paragraph.

### **2.14 Comment 14 - Discussion and Conclusion**

P12, L3: Delete sixth word "in".

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Thank you, we agree one word definitely is too much. We will correct the sentence appropriately.

## 2.15 Comment 15 - Discussion and Conclusion

P14, L32: Concerning precipitation intensity (see also Abstract): I think the study does not show, that the precipitation intensity increases. The rainfall intensity (or I would say "rainfall amount" because I associate intensity with shorter event of up to 72 h) increases due to higher fraction of liquid precipitation. Less snow, more rain... But is the total amount of precipitation increasing? If yes, I missed this result before.

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Yes, you are right. It is better to talk about "rainfall amounts" or "totals", not "rainfall intensities". With regard to rainfall, we currently investigate the five days before an event. Our results indicate, that the 5-day sums are changing. We will change our manuscript accordingly.

## 2.16 Comment 16 - Discussion and Conclusion

P15, L14: Here one could mention the lake of Constance, that has a considerable influence on the flood magnitude at gauge Basel. The lake of Constance is a big storage for the snow melt from the "Alpenrhein". By the way, the lake is not shown on the maps (and I wonder if it is part of the mHM). At least one should briefly mention the lake and its effect in general.

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We will include further information on lakes and their influence on flooding in the Rhine Basin. Yes, the Lake Constance represents a large storage and has a strong dampening effect. We will extend corresponding paragraphs in the discussion and conclusion accordingly.