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Interactive comment on "Temperature signal in suspended sediment export from an Alpine catchment" *by* Anna Costa et al.

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We thank Referee #1 for his helpful review. We have analysed her/his suggestions and we report in the following our response to each specific comment.

1. Lines 20-35, page 2: Description of catchment sediment sources. Given the number of figures in the manuscript, I suggest the authors remove the overly simplistic schematic in Fig. 1 as it adds little beyond that which is available from the summary in the text.

We agree with Referee #1 and we will remove Fig. 1 from the revised manuscript.

2. Lines 20-25, page 4: The discussion of anthropogenic impacts in the catchment mentions gravel mining operations along the main channel and tributaries. Such direct

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disturbance of the channel could increase suspended sediment supply. Can this effect be discounted completely as a factor contributing to the observed trend in suspended sediment concentration (Fig 7c)?

We are aware that, for short periods after river bed disturbance, gravel extraction may cause local releases of fine sediments from the river bed. However, this process is unlikely to affect the suspended sediment load and balance at the outlet of the basin over seasonal and annual timescales. This is confirmed by the volume of gravel extracted along the main Rhône River and along tributaries, available from 1989. Annual volumes of gravel extracted, expressed as difference from the average over the period 1989-2014, do not show any clear correlation with mean annual suspended sediment concentration (Fig. 1). In agreement with Fig. 1, the coefficient of determination between the two variables is very low (R2 = 0.08). Therefore, we conclude that, although gravel mining data for comparing the periods before and after mid-1980s are not available, gravel extraction is unlikely to play a significant role in the suspended sediment concentration rise observed in mid-1980s.

3. Lines 10-15, page 6: Table 1 summarises some of the information given in Section 4 Data Description. Moreover, Section 3.3 Calibration and Validation also contains some description of the datasets used. To reduce repetition, can section 4 be shortened or consolidated? Perhaps a shortened descriptive summary of the datasets could be provided alongside Table 1 before introducing the models.

We agree with Referee #1. We will maintain Section 4 but we will reduce it. Particularly, we will shorten data description in Section 4.1 (Precipitation and Air Temperature) and Section 4.2 (Discharge and Suspended Sediment Concentration).

4. Lines 30-35, page 10: Could the use of fixed interval sampling (twice per week) for suspended sediment concentrations (SSC) influence the interpretation of trends during the observation period? The absence of continuous measurements (i.e. turbidity) or stage-triggered sampling may result in under-estimation of mean annual SSC because

elevated but short-duration peaks in flow and SSC are less likely to be captured by fixed interval sampling. For this reason, the potential effect of the reported increase in direct rainfall on snow-free surfaces ('effective rainfall') on SSC could be underestimated because such events are short duration compared to the longer duration ice and snowmelt effect on SSC. This deserves consideration when evaluating the relative contributions of rainfall, snow and ice-melt (page 18) to observed trends in SSC.

We thank Referee #1 for this constructive comment. We agree that discontinuity in the sampling procedure may indeed influence the interpretation of trends in suspended sediment concentration, and we will discuss this in the revised manuscript. However, although it is true that the manual suspended sediment sampling is not conducted on extreme flood days, the sampling is representative of the probability distribution of daily streamflow – we will show this in the final response to the reviewers and the revised manuscript. We have also redone all our analysis of changes in annual ER, SM, IM based on rates computed only on days when suspended sediment was sampled and we find that the results are unchanged. The figures supporting this will also be added in the final response to the reviewers and the revised manuscript.

5. Sections 5 & 6: I recommend merging the Results and Discussion. The Results section contains some elements of discussion (e.g. lines 20-25, page 15, on climate patterns), while in multiple locations within the Results section the authors write 'see discussion'. The integration of Results and Discussion could produce a more coherent paper that presents findings and their interpretation in relevant sub-sections. For example, the discussion of snow and ice-melt modelling in terms of previously reported melt factors (lines 10-25, page 20) would fit logically with the presentation of the calibration results (section 5.1).

We agree that sections of results and discussion can be organized in a more coherent structure. In the revised manuscript, we will move the discussion on snow and ice-melt modelling (Section 6.1) to the section on models calibration (Section 5.1). In addition, Section 6.2 and 6.3 will be merged and reduced, maintaining only the most significant

discussion points.

6. Section 6.2 (lines 15-35, page 21): The discussion of future climate change effects on the sediment regime should be shortened and focus mainly on the point about the value of a more process-based approach. The paper offers no evidence based on future change simulations, so should limit speculative discussion in this area.

We agree that the discussion on climate change projections in Switzerland of Section 6.2 is too extended. However, as suggested by Referee #1, we would like to focus on the importance of adopting a more process-based approach when analysing the effects of climate change on suspended sediments. Therefore, we will reduce the discussion and we will merge Section 6.2 with Section 6.3. By linking these two sections, we aim at emphasizing that looking at erosional and transport processes driven by different hydroclimatic variables may allow the quantification of the effects of changes in climatic conditions on the sediment regime.

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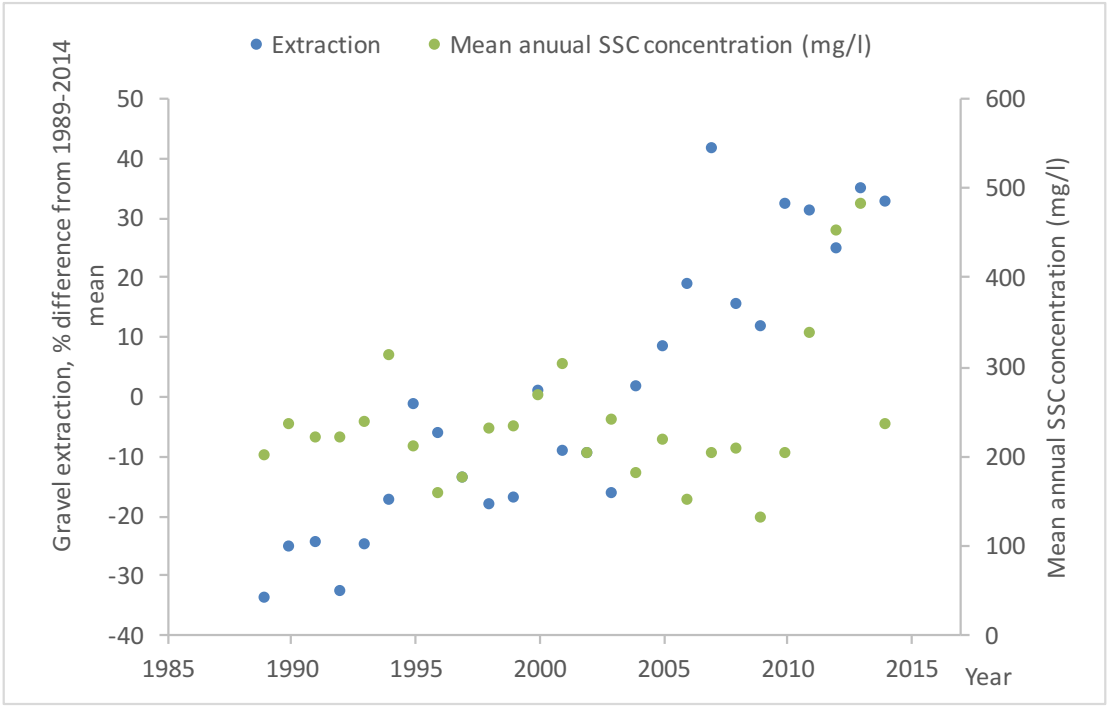

Fig. 1. Fig. 1: Mean annual suspended sediment concentration (SSC) and total annual volume of gravel extracted, expressed as difference from the average over the period 1989-2014

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