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Interactive comment on "Reconstructing the Salgar 2015 Flash Flood Using Radar Retrievals and a Conceptual Modeling Framework: A Basis for a Better Flood Generating Mechanisms Discrimination" *by* Nicolás Velásquez et al.

Anonymous Referee #1

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The paper of Nicolás Velásquez et al., entitled 'Reconstructing the Salgar 2015 Flash Flood Using Radar Retrievals and a Conceptual Modeling Framework: A Basis for a Better Flood Generating Mechanisms Discrimination' addressed: i) the flash flood forecast issue, specially assessing flood plain and landslide occurrences, and ii) the understanding of flood processing mechanisms during two contrasted flash flood events, using virtual tracers of water origin and paths.

The authors proposed a novel and ingenious method as it is adapted to the data scarcity of the region. The overall method is specially of interest as it does not pro-

vide only flood flows, but also the localization of flood plains and landslide, which are critical information for stakeholders. Finally, the work provided a rare and interesting double flash flood event study located in the Northern Andes mountains, which actually supports numerous extreme hydrological events but are scarcely documented.

However first at all, the paper having two distinct objectives, it suffers from clarity. The descriptive potential of the model, tracing water origins and paths, as well as the 'low cost' method for assessing floodplain and landslides are both interesting works, but both are totally independent. I would suggest to either follow the process understanding objective or the forecast one.

In addition, the applied method suffers from a lack of validation and the limits of the results are poorly explained. While all the results are tributary of the hydrological model, the maximal peak discharge, used as solely validation criteria, should be more carefully calculated and discussed. The equifinality issue in the hydrological model is not presented and this is clearly missing, as it does have consequences when assessing flood plains and landslide. Explanation of the models, calibration set up should be provided. It is not clear how the parameter are set up according to whether the catchment properties, literature values or adapted through calibration for hydrological likelihood purposes. Finally the limits of the results, assessing the floodplain and the landslide areas, should be discussed in the appropriate section and compare to literature.

The manuscript does not properly respect the announced structure and some paragraph should be reorganized (see below). Also note that numerous annotations are missing, and makes difficult to understand the scientific assumptions beyond several equation (specially I personally didn't understand the flood plain method).

###- Specific comments

Please note that the proposed rewriting are suggestions that may clarify my concerns and comments. Please feel free to consider and modify those drafts.

1. Abstract: quite long : the first 8 lines might be removed.

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2. Introduction: the introduction is too long. The bibliography done is significant but irregular and sometimes out of the scope. I would suggest to follow the plan : i) Flash flood: definition, hazard risk; ii) Catchment and meteorological features controlling the flash floods AND landslides processing; iii) Flash flood in Colombia, the specific Salgar flash flood events; IV) ssue : Flood forecast and modelling with scarce data; V)Objectives of the paper, method, plan.

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3. Introduction: I would suggest the following modifications:

3.1. from page 2, line 52 to page 4, line 106 : the literature should be more concise and be reduced up to 2 or 3 paragraphs. The plan of the statements declared page 2, line 48 – 52 should give guidelines for the organization of the paragraphs.

3.2. Page 2, line 53 – 55 and page 4, line 108 – 116 : to my point of view, those lines are out of the scope and could be removed, making clearer the introduction.

3.3. Page 125 – 129 : are the figure related to Colombia alone or the Caribbeans and the South of America? As the paragraph starts with a description of Colombia, I suggest to give statistics related to the country itself, in order to avoid confusion.

3.4. Page 5, line 131 – 148 : the full description of the events should be located in the 'Data and area of the Study'. Here a succinct description with argument for showing the interests of that particular study case are expected. As example: 'The paper focuses of two consecutive rainfall storms that took place in May 15th and May 18th 2015 in La Liboriana upstream, a 56 km2 catchment located in the Western range of the Colombian Andes. The resulting flash floods dramatically affected the local population, leading to more than 100 casualties, and to an estimated total cost of 36 000 millions Colombian pesos ($\sim$ 12.5 millions \$, considering the 2018 rate) for infrastructure reconstruction

and community supports. In spite of the data scarcity, including discharge measurements, that two successive events provide an interesting study case for assessing the flash flood mechanism processes with contrasted rainfall forcing distribution and soil moisture conditions.'

3.5. Page 5, line 161: At the end of the paragraph, it should be specified which method is chosen here (the third one, I guess).

3.6. Page 6, line 175 – 191: here again the description of the method should be more concise and detail has to given in the third section. I suggest the following modifications: 'The methodology followed in this study makes use of a conceptual modeling framework that includes a hydrological model (Vélez (2001) and Francés et al. (2007)), a shallow land-slide sub-model (Aristizábal et al., 2016), and a hydraulic sub-model (HydroFlash). The hydrological model includes virtual tracers to explore separately the role of runoff and subsurface flow, as well as the relative importance of convective and stratiform precipitation in flash flood generation. A comparison between the results from both sub-models and the observed landslides scars and flooded spots helps to evaluate the overall skill of the proposed methodology.

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4. Section 2: Study site and data

4.1. To clarify the structure, two subsections might be established: 2.1 = Catchment description / properties – 2.2 = Flash flood event observations

4.2. Figure 2: Please indicate the size resolution of cells used when calculating HAND.

4.3. Pages 8-9, lines 218 – 245 : Maps of the slopes, vegetation cover (even roughly designed), and soil properties would provide a better illustration of the description.

4.4. Figure 3: The information content of this figure is quite repetitive with the figure 2. I suggest to remove it.

4.5. Page 9, lines 235 – 245 : soil information. The lines 236 and 240 are not of interest and could be removed. In contrast, some information about how Osorio (2008) obtained the data could be relevant.

4.6. From page 9, line 246 to page 10, line 255. The description of the data used for validation of the models should be more detailed in this section. Specially we should find the following information : How was determine the maximum flood discharge, the landslides and flood plain areas ? Which data were used ? Which method was used to extracts area contours as showed in the results ? Which uncertainty ?

4.7. Page 9, line 253: 'Assuming flow speeds between 5 and 6 m.s-1' Please give more detail about this assumption: is it according to literature value? Or the ange of speeds were calculated from the section roughness and stream bed slope consideration (as Neppel et al, 2010) ? Is there also an estimation of the flood peak time?

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5. Section 3: Methodology

5.1. This section in the current form is difficult to follow, as the description jumps from one model to another and finally comes back at the first mentioned one. I would suggest to reorganize this section in order to follow the method firstly announced in the introduction : 3.1 hydrological model description (that have to include hydrological scheme modification and the tracers implementation within the hydrological model); 3.2 landslide model description; 3.3 floodplain model description. Rainfall data processing has to be presented in Section 2.

5.2. The methodology section should strictly provide the method description, and the underlying assumptions made. Any argument to justify the objective of the study should be remove from this section (as example : lines 293 – 302; 316 – 319; 326 – 332; 345 – 347; 375- 382).

5.3. The Figure 5 should be the key figure offering a clear visual description of the

overall method applied in this manuscript. To my understanding of the achieved work, this diagram should rather have three levels (top to down of the diagram): i) two panels showing the data inputs of the hydrological models, i.e. the DEM, the radar-based QPE, and the radar-based QPE processing according to Steiner, 1995); ii) one panel showing the hydrological model (Francés, 2007); iii) three panels showing the 3 results of the overall methods : the discharge simulation with water origins and paths information, the landslides submodel, and finally the flood plain assessment.

5.4. Descriptions of the models : it should useful to clarify through tables, which parameter/information is required, how the parameters were set up (calibration ? literature value, observed data?), and whether they are spatially distributed or uniform.

5.5. Flash flood model (I would say flood plain model) : I personally have some trouble to understand the method applied. There is no reference or explanation of the assumptions behind the equations (10, 11, 12). In addition, several symbols are not defined: $C_{j,s}$ C_{max}, and others are detailed ($S_{i,0}$) while not used in the equations, suggesting that an equation is missing in the manuscript.

5.6. Page 16, line 423: About the hydrological runoff modification : why did you proceed to this modification? Is an adaptation of the model to the studied catchment?

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6. Section 4 : Results

6.1. In the current manuscript's form, the section 4 contains only one subsection, which doesn't make sense. One logical plan considering the objective of the paper should be: 4.1 Validation of the hydrological model; 4.2 Description of the flash flood mechanism processing; 4.3 Assessment of the landslide simulation; 4.4 Assessment of the flood plain simulation (or 4.3 and 4.4 could be also merged).

6.2. The description of the flash flood mechanism processing are really detailed while the other results are summary explained : to be more balance

6.3. fig 12: if I understand well, the figure 12 shows spatial distribution characteristics of the precipitation over the catchment, but it is not a result of the hydrological simulation. This figure 12 should be better located in the section 2.

7. Section 5: the discussion deals only with the description of the hydrological simulation. The discussions on the landslide model and on the flood area assessment are clearly missing.

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###- Technical comments

T1. page 6, line 199: section 5

T2. page 7: reword the section 2 'Study site and data'

T3. Figure 2: remove 'Las margaritas village' as it doesn't appear anywhere else in the text.

T4. Page 9, line 246: please write 'carried out for assessing' instead of 'instrumental in obtaining'

T5. Page 9, line 246: specify 'after the second flash event'

T6. Page 10, line 268 : write 'minute' instead of 'min'

T7. Page 10, lines 269 – 274. The sentences were twice written. Please, remove the duplicate.

T8. From page 9 line 246 to page 11 line 274. The two paragraphs give i) the available observations used in the study for assessing the hydrological model and sub-models and ii) the rainfall input data used to force the hydrological model. I would change the order to respect the chronological use of the data. In addition, I would suggest to add a table summarizing the observation information available and used to validate the models.

T9. Figure 5: we can't read any legend of the hydrological model, please uniform the size of the annotation in this figure.

T10. Page 11, line 285: what is Ri?

T11. Page 11, line 304 - 307: this information has to be provided at the end of the manuscript.

T12. Page 15-16: please revise all the symbol definition of the Hydroflash model.

T13. Page 16, line 426: please define A in the vicinity of it first occurrence

T14. Figure 7: the peak discharge interval used for validation should be indicated in this figure.

T15. Figure 9 and 10: These figure 9 and 10 might be merged, presenting on the left side the 50 groups categorization (right panel of the figure 9), and the current figure 10 on the right side. The same key color defining the 50 groups categorization should be used in the map (Fig. 9) and to define somehow the related scale of the fig. 10.

T16. Along all the manuscript, the unity has not to be in italic font. In addition, change the annotation m/s to m.s-1.

###- References:

Neppel, L., Renard, B., Lang, M., Ayral, P.-A., Coeur, D., Gaume, E., Jacob, N., Payrastre, O., Pobanz, K. & Vinet, F. (2010) Flood frequency analysis using historical data: accounting for random and systematic errors. Hydrol. Sci. J. 55(2), 192–208.