

Review: Referee 2

P1L15: A review of the state of the art works is missing; you should add it. Some examples papers: Caine 1980; Aleotti, 2004; Cannon et al. 2011; Rosi et al., 2015 (10.1007/s11069-015-1717-7); Battistini et al., 2017 (10.1016/j.apgeog.2017.03.003); Segoni et al., 2018 (10.3390/w10101297).

Answer: The introduction section was modified in accordance with the suggestions. A literature review was provided to describe the existing state of the art works. All the suggested reviews Caine 1980; Aleotti, 2004; Cannon et al. 2011; Rosi et al., 2015 (10.1007/s11069-015-1717-7); Battistini et al., 2017 (10.1016/j.apgeog.2017.03.003); Segoni et al., 2018 (10.3390/w10101297) were included in the revised introduction.

P2L8: please add a reference

Answer: We did. A reference was provided (Youssef et al., 2014). Please refer to P2L14–15 in the revised text.

P3L3: How did you combine these images?

Did you do a mosaic or something else? Please clarify

Answer: two data sets were combined together to create the time series database. The steps have been explained in P5L9–10 about spectral resampling and averaging.

P4L6: Even if it is clear, you have to clarify all the acronyms the first time they are used.

Answer: the acronyms for TRMM and GPM were spelled out for the first time in the original (P2L13, P2L14, respectively) and in revised text (P2L19, P2L20, respectively).

P4L6: a MAP, not "an MAP"

Answer: Text was corrected. Please refer to P5L8–9 in the revised text.

P4L7: Even if it is clear, you have to clarify all the acronyms the first time they are used.

Answer: MAP was defined for the first time in the original text (P1L29–30) and in the revised text (P2L6)

P4L8: In general, this is also a very low value

Answer: Agree. The text was revised accordingly. Please refer to P5L8–9 in the revised text.

P5L5: Please specify Intensity and Duration

Answer: We did. ID already specified in P2L10 in the revised text.

P5L11: clarify Acronyms

Answer: As indicated earlier, TRMM and GPM were spelled out for the first time in the original text (P2L13, P2L14, respectively) and in revised text (P2L19, P2L20, respectively).

P6 Step II, box 1: in page 5, row 11-13, you did not mention ASF. Be sure that text and figures report same info.

Answer: ASF was spelled out in Figure 3 P6 Step II, box 1 and in the text. Please refer to P11L9–10 in the revised text.

P6 Step II, box 2: Typo “pixe” should be “pixel”

Answer: Typo corrected in revised text. Please refer to Figure 3 in the revised text.

P8L11: these values are very very low, if compared with literature works. I believe you should add a more detailed geological and lithological description of the study area, since these factors, as well as MAP and morphology of the slopes, can influence the rainfall amount needed to trigger landslides.

Answer: Detailed geological and lithological descriptions that explain why the study area is vulnerable to landslide development under modest precipitation conditions were added in the revised text. Please refer to P4L12–17 in the revised text.

P9L2-8: How you defined the duration of storm events? This is a very complex task, widely discussed in literature (e.g. Segoni et al., 2014; Rosi et al., 2015). Did you use an objective approach? or Did you do by subjective judgment? Please clarify

Answer: We clarified in the revised text that we used the peak intensity values, in other words the shorter sections of the precipitation event with the higher intensity were selected. Please refer to P8L15–20.

P9L8: you should also add the work about ID thresholds for Slovenia (Rosi et al., 2016)

Answer: Reviewer 1 indicated that comparisons of the Faifa ID threshold with others with different settings, processes, and backgrounds is not an instructive exercise and requested its omission from the text. We agreed with his reasoning/request and omitted this section. Please refer to Figure 5 in the revised text.

P9L12-13: What do you mean? annual rainfall is not to be considered for the triggering of landslide.

Answer: As indicated in our response to your previous comment, this discussion was omitted from the revised text.

P10L7: this part is very important, but you wrote only few sentences. I suggest to expand the description of the processing phase of Sentinel Images.

a broad literature exists about it (e.g., van Zyl et al., 1993 (10.1109/36.263774); Baillarin et al., 2012 (10.1109/IGARSS.2012.6351959); Karen et al., 2009 (/doi.org/10.1177/0309133309339563))

Answer: The description was expanded to better explain the processing steps. Please refer from P12L1–L14 in section 3.2 of the revised text.

P11L15: you should briefly add a description of the methodology

Answer: A brief description of the methodology was added in the revised text. Please refer to P12L22–29 in the revised text.

P11L15: If you masked pixels with values higher than 0.5 and also those lower than 0.6 you masked out all pixels of the area. Please Clarify.

Answer: the >0.5 dB refers to a backscatter threshold value that is indicative of a corner reflector, whereas the <0.6 value refers to another threshold, the R visibility threshold. Areas with low R values <0.6 are areas of low visibility. The text was revised to further clarify this distinction. Please refer to P12L15–18 and L12L27–29 in the revised text.

P11L25: Can you add an example image?

Answer: Figure 7b is an example of a difference image for two descending scenes bracketing (acquisition dates: December 24, 2015 and February 10, 2016) a precipitation event on December 25, 2015

P12: It is very hard to believe that this landslide has been caused by rainfall, since it looks like a rock fall.

Answer: As indicated in the text revised caption, landslides in Figs. 5a and 5b show debris flows triggered by road construction and storms. Landslide in Fig. 5c is caused by failure on fracture planes dipping towards the road.

P13P11: which was the duration of the event? 15 mm is a very low value to trigger a debris flow. Usually from 50 to 70 mm in 1 hour are required for debris flow. Maybe you should also consider the rainfall recorded in the days before (antecedent rainfall).

Answer: In our response to your earlier comment (P8L11) we provided geological and lithological description of the study area that could explain why the study area is vulnerable to landslide development under modest precipitation conditions. Please refer to P4L9–16 in the revised text. We agree that antecedent rainfall, although not included in this study, should be a factor to be included in future studies as indicated in the revised text (P21L25–35).

P14L1: maybe 3a

Answer: With the merging of Figures 2 and 3, this has become the correct Figure number. Please refer to P15L1 in the revised text.

P14L6: Maybe Identified, not predicted.

Answer: Corrected in the revised text. Please refer to P15L10 in the revised text.

P14L 12-15: This is not a model refinement, nor a validation. Please consider to move this part in another section.

Answer: This paragraph was omitted from the revised text as it was deemed unnecessary.

P15:2 from the comparison of these 2 figures, it looks like several yellow dots are present in landslide-free areas. I suggest to add the perimeter of landslides in fig. 8a

Answer: The backscatter difference images are sensitive to fine scale changes in roughness on the pixel scale. Such changes on such fine scales might not be obvious from inspection of the temporal Google Earth images. Please refer to P20L2–3 in revised text. We added white arrows to point the distribution of landslides in Fig. 7a and to facilitate comparisons with areas showing large variations in backscatter (Fig. 7b).

P15L7: There is not any figure 2a in the paper.

Maybe 3a.

Answer: With the merging of Figures 2 and 3, this has now been the correct Figure number. Please refer to P17L2 in the revised text.

P16L3: ID are curves, not lines; they appear as lines in log-log plot. Please use only Curves

Answer: Corrected in revised text. Please refer to P18L2–4 in the revised text.

P16L5: see previous comment

Answer: Corrected in revised text. Please refer to P18L2–4 in the revised text.

P16L10: to define ID curves are needed several events that triggered 1 or more landslide. you defined a threshold for 1 event with 1 landslide! you should merge the data for more landslide with similar features (e.g., all landslides on stable location).

Answer: We have modified Figure 8 and the associated text (P18L10–22) based on the comment as we demonstrate the upward translation of the Faifa ID curve for stable area. We developed the ID curve for Faifa Mountains based on available landslide inventory and satellite precipitation data. Based on some isolated landslides on these stable locations, we determined that their ID curve will be located further up in the ID plot as only stronger storms were triggering landslides in those places.

P17L1: You cannot define a threshold with 1 event; even if you suppose the same trend of the red threshold. It is not acceptable to define a statistic with 1 data.

Answer: Please refer to the previous answer provided for comment P16L10.

P17L10: Did do you use the same set of thresholds for all pixels or they vary from pixel to pixel?

Answer: The intercept of the threshold varies from pixel to pixel, but not the slope.

P18L2: your threshold (red line figure 9), indicates ca. 2.75 mm for 1 hour). What is this new threshold? Is it only to remove lower rainfalls?

Answer: Our threshold is 1 mm/hr from TRMM and GPM on the figure and in the text because those sensors have been found to mistake fog for rainfall (Milewski et al., 2009). Please refer to P8L20-22 in the revised text. Figure 9 shows all the rainfall (black and white dots) during our study period (field and radar data observation, P2L24) that were higher than the threshold of 1mm/hr.

P18L16: please split this section into 2 sections: 1) Discussion (with limitations); 2) Conclusion (with future developments).

Answer: We did. The previous section has been broken into discussion and conclusion