Interactive comment on “Constructing a complete landslide inventory dataset for the 2018 Monsoon disaster in Kerala, India, for land use change analysis” by Lina Hao et al.

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Thanks for all the constructive comments and suggestions. We have revised the manuscript and responded to all the comments. Details of the responses were in the supplement document.

Comment 1: “The introduction explores comprehensively the available literature although the objectives in mind are not very clear.”

Response: Thanks for your constructive comments. Our main objective as stated in the last sentences of the introduction: “The main objective of the study is to develop a comprehensive event-based landslide inventory database for the 2018 Monsoon in Kerala, that can be used to analyze to what extent these landslides were affected by land use changes.” In order to make the introduction section more clearly, some redundant description were deleted, while others related to our methodology description were added. Details of the revisions are as following:

1) The original Line 55 to Line 59 of “such as supervised classification (Lacroix et al., 2013), Object Based Image Analysis (OBIA)(Behling et al., 2014;Casagli et al., 2016; Keyport et al., 2018; Lahousse et al., 2011; Mohan Vamsee et al., 2018), Markov random fields (Lu et al., 2019; Qin et al., 2018), random forests (Stumpf and Kerle, 2011), support vector and other machine learning methods (Lei et al., 2019) or a combination of various algorithms (Aksoy and Ercanoglu, 2012; Li et al., 2016; Lu et al., 2011; Stumpf and Kerle, 2011).” was deleted. The related references were also deleted.

2) Other irrelevant contents such as “UAV, SAR, InSAR” in the original line 59 and 60 were also deleted.

3) “The availability of multi-sourced and multi-temporal high resolution satellite images (HRSI) on the Google Earth platform with 3D viewing capabilities (Crosby, 2012; Fisher et al., 2012) offered major advantages for landslide inventory mapping (Mohammadi et al., 2018). Many authors have generated landslide inventories using the Google Earth platform (Rabby and Li, 2019; Sato and Harp, 2009; Fiorucci et al., 2011; Borrelli et al., 2015). It has also proven to be possible to map event-based landslides by comparing images before and after the event using Google Earth history Viewer (Xu et al., 2014a, 2014b). However, recognizing and mapping specific types of landslides such as rainfall triggered shallow landslides over large areas can be still challenging when using automated techniques. Field verification is only feasible for a limited number of landslides, as it is time and labor intensive, and many landslides may be difficult to access. Therefore, visual image interpretation using HRSI from different time periods may be the best solution. Landslide mapping and classification requires mapping experience and the availability of high resolution images in three-dimension views, either
using stereo images, or oblique views such as in Google Earth, allowing to recognize
the specific diagnostic features (Soeters and van Westen, 1996; Zieher et al., 2016),
was added in the introduction section. Also the related references were added in the
reference list.

4) The order of some sentences was also modified in paragraphs in the introduction
section.

5) The related references was added in the bibliographic list.

comment 2: “In the section 3.1 Landslide mapping, the authors should consider to
clarify the following points: Please, indicate what LULC means (land use land cover?).”
Response: LULC means Land Use and Land Cover in section 3.1 Landslide mapping.
The detail of LULC was supplemented in the revisions in the last paragraph of the intro-
duction section as follows: “This manuscript focuses on the generation of the dataset
consisting of a detailed landslide inventory with land use/land cover (LULC) information
for two periods: shortly before the event, and almost a decade older.”

comment 3: “Despite the difficulty in identifying landslide from photos and sometimes
establish elementary diagnostic features, it will be very helpful if the authors explain
how superficial slide (SS) can be distinguished from debris flow (DF); and the latter
from rock fall (RF), considering the different sources at stake.”
Response: Thank you for this comment. We have added the following sentences to
description how to discrimination of SS, DF and RF. Also the related reference for the
discrimination was added in the reference list. “Based on the diagnostic features de-
scribed in Soeters and van Westen (1996), debris flow (DF) features were differentiated
from shallow landslides (SS) by the presence of a runout zone, often reaching to the
nearest stream, which is not the case for SS. Rock fall features (RF) can be differenti-
ated from the other two processes as they occur on very steep and bare rocky slopes.”

comment 4: “Bearing in mind that the images have too coarse resolution for a proper
correlation with mass movements, how you can discriminate the different landslides?”
Response: Landslides were mapped from multi-temporal sub-meter high-resolution im-
geos in Google Earth’s history viewer, which allowed us to differentiate the three types
of landslides according to their discernible image features. Details of discrimination of
the three types of landslides were mentioned in the response to comment 3.

comment 5: “Could the authors give comprehensive explanations why the majority of
the landslides, in the 2018 monsoon event, occurred mainly within forest areas? This
behavior is mentioned several times, included in the 6 Discussion and conclusions
Taking this aspect into account, the authors might include previously, in the section 2.1
Study area, a description regarding the topographic and orographic characteristics of
the entire zone. As you know, the slope is a critical issue for this type of movements in
addition to a major triggering event. At a same time, those areas are not attractive for
human activities.”
Response: This paper is mainly focusing on the generation of the comprehensive land-
slide inventory after the 2018 monsoon event. We are writing a follow-up paper in which
we analyzed the land use / land cover changes and evaluate these changes. As this
paper is focused on the data collection part, we do not give such a comprehensive
explanation in this manuscript. The topographic and orographic characteristics of the
study were given in the “2.1 Study area” section. However, we would like to answer to
this comment briefly here. There are two reasons that the majority of the landslides
occurred mainly within forest areas in the 2018 monsoon event.

1) The land use map of 2010 from KSDMA (Kerala State Disaster Management
Agency) used in this research as a reference to distinguish natural forest from forest
plantation, indicates that the forest coverage rate (natural forest and forest plantation)
is 76.51% in this area. The forest coverage in steep areas is even higher, which are
more susceptible to landslides. Also, a large part of Kerala is covered by forest (natural
forest or forest plantation) confirmed by literatures (Kumar 2005; Roy et al. 2015; Kale

2) Physiographically, the west of Kerala consists of coastal plains covered mainly with built up areas and agriculture such as paddies. The eastern part of Kerala is within the Western Ghats with rugged mountains and deep valleys covered with forest and forest plantation. Most of the landslides triggered in the 2018 monsoon event thus were in the eastern mountainous parts of Kerala.

comment 6: “Please, check bibliographic list. Lines 314 and 316: the references Sahana (2019); Ramachandra and Bharat (2019) are not listed.”

Response: Thank you for pointing this out. We checked all the references and added the missing references. The references of Sahana (2019), Ramachandra and Bharat (2019) were supplemented in the bibliographic list.

Please also note the supplement to this comment: