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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Before the fire: Assessing post-wildfire flooding and debris-flow hazards for pre-disaster mitigation" *by* Ann M. Youberg et al.

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General Comments: The authors appreciate the time and efforts of the three reviewers of this manuscript. The comments and suggestions made in these reviews have helped us to refocus and reframe the manuscript. This requires a significant re-write on our part, and we are continuing to work on the manuscript. Here, we present our rational for why this is an important and original contribution, and the scientific questions we address in this revised manuscript. We then address each reviewers' individual comments. The post-wildfire debris flows and flooding following 2010 Schultz Fire near Flagstaff, Arizona, significantly impacted forest resources, downstream developed ar-

eas and the local economy, which we have described in our paper. This scenario, unfortunately, is not unique to northern Arizona (e.g. Kean et al., 2019; Cannon and Gartner, 2005), nor to the western United States (e.g. Jordan, 2016; Nyman et al., 2015). More densely vegetated forests, longer fire seasons, drought and other climatic influences are expected to contribute to general trends of more frequent and severe wildfires (Kitzberger et al., 2017; Littell et al., 2016; Liu et al., 2013; Krawchuk et al., 2009). This highlights the need for local and regional entities to consider and plan for wildfires and their post-fire impacts to reduce risks and increase community resiliency (Schoennagel et al., 2017).

We hypothesize that risks from post-wildfire debris flows and floods can be assessed, prior to the start of a wildfire, as a function of probability of occurrence, predicted magnitude of flow, and the projected distribution of inundation, and that these data can then be used to identify planning-level risk zones and mitigation opportunities to reduce risks and increase resiliency. Here, we use a post-Schultz Fire dataset that we have compiled over years of working in this area (described below) to test and evaluate the USGS models used to predict the probability of occurrence and magnitude of post-fire debris flows, and Laharz for modeling, prior to a wildfire, potential post-fire debris-flow inundation zones. Most of this work was described in detail in an appendix to the Open File Report (OFR) we referenced in our paper. Here, we describe in more detail that work, and we include a more robust assessment of Laharz by comparing model results with mapped deposits using receiver operator characteristics (ROC) analyses (Fawcett, 2006). We also use our dataset to compare mapped flood inundation areas with modelled FLO-2D inundation zones, again using ROC. Finally, we evaluate the methodology used in this study to assess potential post-fire hazards before a wildfire begins to assess 1) what could be done better, and 2) how other communities could adapt this methodology for their own use.

While the Schultz Fire is only one small fire, the authors, through our continued work on the post-Schultz Fire flows, have a unique dataset of detailed rainfall data, geomorphic

responses of burned basins to rainfall, geomorphic mapping of flood and debris-flow deposits on the piedmont below the burned basins, and 1- and 2-dimensional modeling of design-storm flood flows immediately after the fire and in the years following the fire that are used to inform mitigation efforts and to document post-fire hydrologic recovery. Moreover, there is high resolution (i.e. 1 m) elevation data derived from airborne lidar for our entire study area. Additionally, Coconino County Flood Control District has mapped extents of flood inundation within the burned area and through the downstream developed areas from the July and August, 2010, storms. Therefore, the Shultz Fire presents a rare opportunity to develop and test a methodology that can be more generally applied to assess risks from post-wildfire debris flows and floods.

Reviewer #1: This manuscript does not conform to the stated format of the journal, which asks for "...original research on natural hazards and their consequences." While the writing and figure production is of high quality, this is not an original piece of research and unfortunately is not fit for publication in a scientific journal (it would be a perfectly acceptable project/technical report). This is a project summary (line 11-12 on page 2), and the figures are not original, see references to the original works in each of the reference captions. There are no hypotheses. They do have several goals for the study, but these goals are not generalized beyond the specific county in Arizona in which the work was conducted. Therefore, it is left to the readers to determine if the work could be used elsewhere. The authors conducted modeling, but they merely state that modeling was conducted (section 3.2 - 3.3). They do not discuss model details, equations, parameter used in the models, or even input data to the models (e.g. no details on actual rainfall rates used). Again, as openly stated by the authors, this is a summary of a study that was done, it is not an actual scientific research publication with original research. The discussion merely restates the methods, but does not offer any analysis that would suggest generalization. They made maps to define non-regulatory risk-zone maps. How do we know that these are actual risk zones? For example, they state "... the flood flow zones are probably fairly well constrained." but there is no evidence to persuade readers that their zones are correct. Moreover, the models do

not provide compelling evidence to persuade readers that either Laharz or Flo2D are applicable for debris flow runout. There are no tests of the models that show they are correct in the county of interest. Consequently, I do not think this manuscript is suitable for publication. If the authors were to: create original text (not just a summary) with testable hypotheses, generalizable results, model details, and a logical justification for their models, I think it may then be suitable for publication.

Reply to Reviewer #1: Thank you for your comments. In our revised manuscript we reframe the paper as discussed above. We also address your comments as follows:

1. We are reframing (in progress) the manuscript around the hypothesis that risks from post-wildfire debris flows and floods can be assessed, prior to the start of a wildfire, as a function of probability of occurrence, predicted magnitude of flow, and the projected distribution of inundation, and that these data can then be used to identify planning-level risk zones and mitigation opportunities to reduce risks and increase resiliency.

2. The revised manuscript contains a more comprehensive description of the proposed models for determining flow magnitude and inundation.

3. In order to test our hypothesis, we synthesize the data collected after the Schultz Fire and demonstrate how it was used to test and evaluate the models.

4. Use ROC analyses (Fawcett, 2006) to assess model performances.

5. Provide a discussion of what worked well with the methodology and how we intend to use our methods for two upcoming assessments.

Please also note the supplement to this comment:
https://www.nat-hazards-earth-syst-sci-discuss.net/nhess-2019-74/nhess-2019-74-AC1-supplement.pdf

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