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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Review article: The use of remotely piloted aircraft systems (RPAS) for natural hazards monitoring and management" *by* Daniele Giordan et al.

Anonymous Referee #2

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Overall This is a review paper relating to the use of small RPAS for natural hazards monitoring and management for five kinds of disasters, such as landslides, floods, earthquakes, wildfires and volcanos. The paper recites many international papers and summarizes their content and results briefly. The focus is on the use of small RPAS (<30kg MTOW) in combination with optical sensor systems (mainly), laser scanners and gas detection systems. The introduction explains the two classes of RPAS and the common workflow of using an RPAS and post post-processing the aerial single images or video streams (nadir and oblique view) by using common Structure from Motion Software Tools (like Pix4, AgiSoft, Capturing Reality, DroneDeploy, etc.) to generate data products like orthophotos and point clouds. The advantages of using RPAS for natural

hazards assessment are well described related to the use of aerial camera systems (for RGB, Multi-/Hyperspectral and TIR range). Possible accuracies of these data products are described too in dependence of using GCPs, a low cost AHRS and/or high end GNSS/INS system in combination with the optical sensor system. This paper is a good introduction to the usage of RPAS for natural hazards monitoring and even latest results are listed - i.e. using deep learning algorithms / CNN for detecting destroyed facades to provide relevant information on-site and in near realtime for first responders (section 2.3). Sadly, there are no recommendations for best practices or open source tools and no comparison or rating of the described workflows of each section (landslides, floods, earthquakes, wildfires, volcanos). Especially for using SfM-Software many publications are available which analyses image processing time, achievable accuracies of resulting data products by using / not using GCPs, alternating flight strips and/or cross strips and AHRS or GNSS/INS solutions and the effects of using a metric or non-metric camera system - i.e. DJI Phantom 4 Pro (metric) and DJI Mavic (sadly not metric).

Comments Line No. 27: You cite the Annual Disaster Statistical Review of 2015. The Citation ADSR, 2015 is missing in the reference section and I suggest to update the statistic numbers by using the latest report of 2016. Line No. 37: You address a crucial point here. Time matters, especially during the disaster assessment or disaster monitoring phase. With a RPAS you are easily able to monitor on-site in real time. Why is there no section in your paper where you discuss reliable or suitable RPAS solutions compared to common satellite based solutions / services. There is also another issue to be mentioned. Capturing high res images or videos can be done on time but the main bottleneck is the time which is necessary to post-process that huge amount of images (i.e. with SfM Tools) to generate maps, mosaics, orthophotos, point clouds etc. Several case studies have been published by http://drones.fsd.ch/en/ which should be considered to take into account. Line No. 45: "contest" or "context" of remote sensing research? Line No. 48: SLR instead of RLS. I suggest to replace by "integrated camera systems" as well to address all kind of optical solutions for RPAS (i.e. bridge cameras, industrial grade cameras, video cameras, etc.). Section from Line No. 52 to

62: I recommend to add the advantage of "micro RPAS are easy to transport into the disaster area“. Foldable Systems (like DJI Mavic) fits easily into a day pack and can be transported safely as hand luggage. Weight matters especially for first responder teams like UNDAC or similar. Section from line no. 83 to 104: I recommend to add some references to papers which analyses possible accuracies by using / not using GCPs and SFM Tools (i.e. Pix4D, Agisoft) or common photogrammetric workflows (i.e. Inpho Match AT). I suggest as well to add some references here to fast mosaicking methods - i.e. PhaseOne and IGI showed promising results with the commercial IGI Mapper System and the German Aerospace Center developed specialized solutions for realtime traffic management (VABENE) and realtime mapping applications (MACS) on manned and unmanned aircrafts. Intro section in general: You name laser scanning and gas detection and also reference on that in section 2.1.1, 2.1.2, 2.1.3, 2.4.2 and 2.5 but a workflow description is missing. I recommend to add this workflow description or to specify the argumentation of using optical sensor systems. Line No. 128: Reference of (ADSR 2015) is missing. Update to ADSR 2016 is recommended. Section 2.1: I recommend to add the main parameters which influence the accuracy of derived DEM and orthophotos (i.e. real GSD, knowledge about interior and exterior orientation parameters, overlap of images, flight strip configuration and used SfM-Software) Line No. 281: First use of SfM-MVS - please explain.

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