RC - Reviewer comment; **AC – Authors comment**

RC - The authors address an interesting and important topic in the field of flood emergency. Several studies are developing methods to integrate remotely-sensed data to produce inundation maps and to estimate hydrological parameters at different time and spatial scale. This study focus on the use of low cost datasets for this kind of activities, applying different datasets at different scale to derive maps and useful hydraulic parameters as Water Depth and Water Level. My overall opinion about the paper is good and I think is suitable for publication. However, I suggest the authors to point out and better explain some aspects of the analyses.

AC - The authors would like to thank Domenico Capolongo for his useful revision and suggestions. We reply point-by-point in this document

RC- 1. The use of Cosmo-sky images at full resolution is nowadays also a low-cost option and would provide a definitely more accurate mapping of the inundated areas. Why this option has not been considered instead of the 60 m x 60 m images?

AC -1. Yes, CSK is a low-cost option, especially on the Italian territory, where the acquisition is also more regular and frequent. Our idea, however, was to use as much as possible FREE-COST satellite data with regular acquisition plans on the whole Earth. When we selected the SAR data to be used, we initially focused on the COSMO-SkyMed sensor because, in our example, the time of the satellite acquisitions were optimal to study the wave of flood. However, the analysis of the backscattered signal as seen by a couple of Sentinel-1 images, acquired before and after (two days later) the flood peak, has allowed us to detect and study the modifications of the terrain backscattered signals in a few isolated areas that were inundated after the flooding peak. This analysis was performed by proper radiometric calibration of the SAR images, ending up with maps of the pre-/post-flooding backscattered signal difference at a spatial resolution of about 20 m x 20 m. Even though a simple CSK preview image was used, the capability to detect the flooded areas was fully preserved. This demonstrates that the detection capability of the inundated areas and the water level is not significantly impaired by using a low-resolution (60 m x 60 m) SAR image. Of course, if we had used a full resolution CSK data, the mapping would have been much more precise in terms of spatial resolution, but with relatively few improvements in terms of detection. See for instance the document at the following link http://emergency.copernicus.eu/mapping/system/files/components/EMSR192_07TORINOSOUTH_DELINEATION_OVERVIEW_v1_100dpi.pdf describing an experiment where a CSKM full resolution image was used to map the flooded area south of Turin.

RC - 2. Please provide more info about the DTM of Regione Piemonte used to calculate WD (for example time of acquisition, errors on z values etc). Furthermore a discussion of uncertainties in WD and WL estimation is needed.

AC -2. The DTM-Lidar was acquired in 2009-2010, the metadata (in Italian) can be found here http://www.geoportale.piemonte.it/geonetworkrp/srv/ita/metadata.show?id=2552&currTab=rndt.

The accuracy of elevation ranges from +/-0.3 m to +/- 0.6 m in urban areas. This accuracy is quite good for our model, and no better DTMs on the whole area are freely available. The uncertainties in our model are more complicated to quantitative evaluate because they depend on many factors. The number of ground-based WD measures as well as their reliability and geolocation represent the main limitations. The interpolation to obtain water table raster is also another source of error. For instance, in the case of Moncalieri where we have good and controlled measurement points, the error can be estimated in the range of +/-0.2 m. On the rest of Po valley the error is greater than 0.5 m. To minimize the errors, we have made several interpolations to detect the best water table raster that defines the real flooded area.

In the manuscript we have indicated the DTM accuracy and spent a few words on the model uncertainty.

RC -3. In the discussion the authors mention InSAR but they do not perform any InSAR processing. They only mention Δσo post-pre-flooding as described in the method section. Please explain.

AC -3. We changed the manuscript to explain our results, better. In the discussion section, we have added: "*We compared pre- and post-flood SAR images of Sentinel-1 making SAR backscattering difference of radiometrically calibrated images. For CSK, we reclassified a simple low-resolution image acquired close to co-flood time. The results show that the timely acquisition of satellite data in the case of a flood event is fundamental: in the areas covered by water (like for CSK data) up to 40% of pixels were correctly classified as flooded and it was possible to detect a clear pattern. On the other hand, SAR is weaker for post-event mapping: in our case, the available data acquired two-three days after the flood (Sentinel-1) support the detection of less than 4% of the flooded area*."

RC -4. At line 509 authors say: "InSAR data showed a good performance in the real-time flood mapping while are weaker for post-event mapping." It is not clear what is intended here for "good performance" and how the performance was evaluated. This aspect needs to be discussed in more detail.

AC -4. As presented in the comment to reviewer 1, in the revised version we have added table 6 where some quantitative evaluation regarding flood detection accuracy/performance have been presented and discussed. We evaluated the performance making a ratio between the flooded detected by automatic processing of SAR data and the real flooded area. For instance, CSK detected 23 % (but higher upstream up to 50% detection) of the area flooded by Po, whereas Sentinel-1 reach only 4%. The false positive cases (not flooded area classified as flooded) were also evaluated in the accuracy assessment (SAR data have less than 5 % false positive).

Table 6.

Sector	Area	Sentinel-2		MODIS-Aqua			CSKM	Sentinel-1
	km^2	$MNDWI_{var}$	$NDVI_{var}$	$MNDWI_{var}$	MLC	SA	Recl Ampl	$\Delta\sigma^o$
Not Flooded	259.5	87%	87%	91%	94%	95%	96%	99%
Flooded area								
- Po	47.8	48%	37%	49%	70%	64%	23%	4%
- Oitana	11.6	49%	42%	60%	11%	36%	37%	1%
- Chisola	7.3	21%	51%	30%	24%	23%	12%	1%
- Chisola urban	1.1	4%	24%					

RC -5. In general I think that in the paper some kind of assessment (better if quantitative) of the results is lacking

AC -5 As introduced in the previous comment, we have added table 6 where we reported some quantitative evaluation of satellite data results. In the manuscript, we have also added more details about the validation process of our results. Some other quantitative data about flood extension and water depth model results in the study area have been added to the discussion/conclusion section.

In addition, as suggested by the reviewer 1, we have added a flow chart that shows our approach for mapping flooded areas. This flowchart is based on the results of our study, but we hope that the schema can be considered for a more general approach for low-cost flood mapping

You can find the new flowchart at the following link:
https://www.nat-hazards-earth-syst-sci-discuss.net/nhess-2017-420/nhess-2017-420-AC1-supplement.pdf