

# Author's response to reviewers

The reviewers' comments and questions are marked in red while the author's response to the reviews including a list of all relevant changes made in the manuscript are marked in blue.

## Respond to Review #2

I want to thank the authors for the adjustments they made to the manuscript with respect to the flooding in the Netherlands. I think this is now much better in line with what is known about the event on the ground.

Respond: We appreciate the reviewer's constructive comments to help improve the quality of the paper.

On the South-East of France I would, however, argue that the authors focus on the wrong explanation. At the moment their results of RAPID are attributed to flooding due to heavy precipitation upstream. Other reasons the authors hypothesize are raised groundwater table or irrigation. I commend the authors on finding the information about irrigation and when it is allowed to do in this region. Contrary to what the authors currently state in the manuscript, however, I strongly believe that irrigation is actually the primary reason for the results of the RAPID analysis. A raised groundwater table due to coastal proximity would be either a more permanent feature, and groundwater in Arlon is too far away from the coast to suddenly rise due to a storm surge (plus I am not aware of a storm at that time). If it was because of river flooding due to upstream rainfall, then the flooded areas should be connected with the main river, as seen in Meuse and IJssel in the Netherlands. Their results (boxes A, B, C and overview map) clearly display that this is not the case. It is very patchy and the patches are rarely connected to the river. This leads me to strongly believe that RAPID actually picked up on irrigation in the area (which is also impressive and an important lesson). I can't state this with certainty (a dry spell in the region preceding July 16 would be an indication if that is found). But the explanation the authors currently have – fluvial flooding due to upstream rainfall – is not consistent with their results (patchy, not connected to river); whilst irrigation would be in line with their results.

Respond: We agree with the reviewer that irrigation could be the primary reason leading to the extensive and patchy flooded area in South-East France. Some additional results are provided to back this up.

From line 113 to 115 at page 4:

*“The croplands labeled as inundated in south-eastern France may be caused by irrigation instead of floods, because the irrigation starts from June 15 in France. As stated in the RAPID algorithm (Shen et al., 2019), RAPID does not tell the cause of an incremental area of submerge so the labeled inundation could be caused by irrigation. But authors intend to leave such reasoning to local flood managers or stakeholders because they have better local knowledge and therefore do not think such limitation could cause an issue in disaster response.”*

Shen, X., Anagnostou, E. N., Allen, G. H., Brakenridge, G. R., & Kettner, A. J. Near-real-time non-obstructed flood inundation mapping using synthetic aperture radar. *Remote Sensing of Environment*, 221, 302-315, 2019.

First, by overlaying the RAPID flood map with the global map of the irrigation areas of coarse resolution, obtained from Food and Agriculture Organization (FAO) of the United Nations (<https://www.fao.org/aquastat/en/geospatial-information/global-maps-irrigated-areas/latest-version/>), we find high spatial correlation between the patchy flooded area and the area equipped for irrigation over south-east France. While irrigation is permitted from June 15 up to August 15 in France, it is possible that these regions in south-east France have been irrigated and therefore are detected by the RAPID system as flood during the flooding period (July 15 to July 21, 2021). In the original paper of RAPID, authors concluded one of the limitations is that RAPID does not differentiate the cause of an incremental area of submerge.

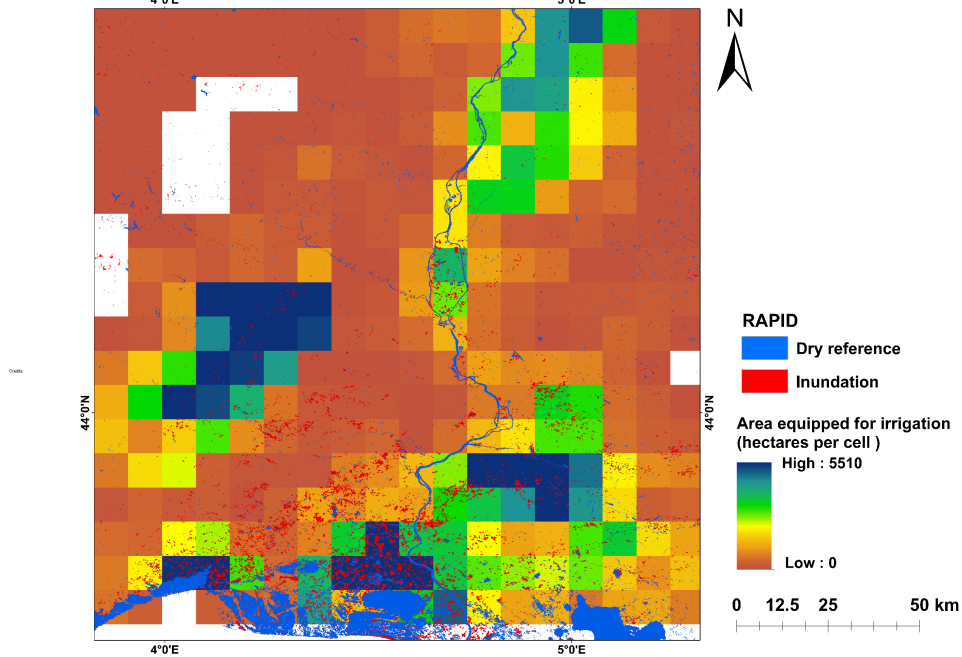


Figure 1. RAPID flood map and global map of the irrigation areas over south-east France.

Second, from one image on May 30, before the official irrigation time, we do not find those patchy water bodies in south-east France, which appears on the dry reference image, used in this study, on June 22 (Figure 2 (a)). Based on the precipitation map from IMERG data, the total precipitation is only around 10 mm over the areas which cannot be the cause of patchy water bodies appearing on June 22. The irrigation started from June 15 could be an explanation. Similarly, the extensive patchy flooded areas in the RAPID flood map on July 16 (Figure 2(b)) might also be caused by the irrigation over these regions.

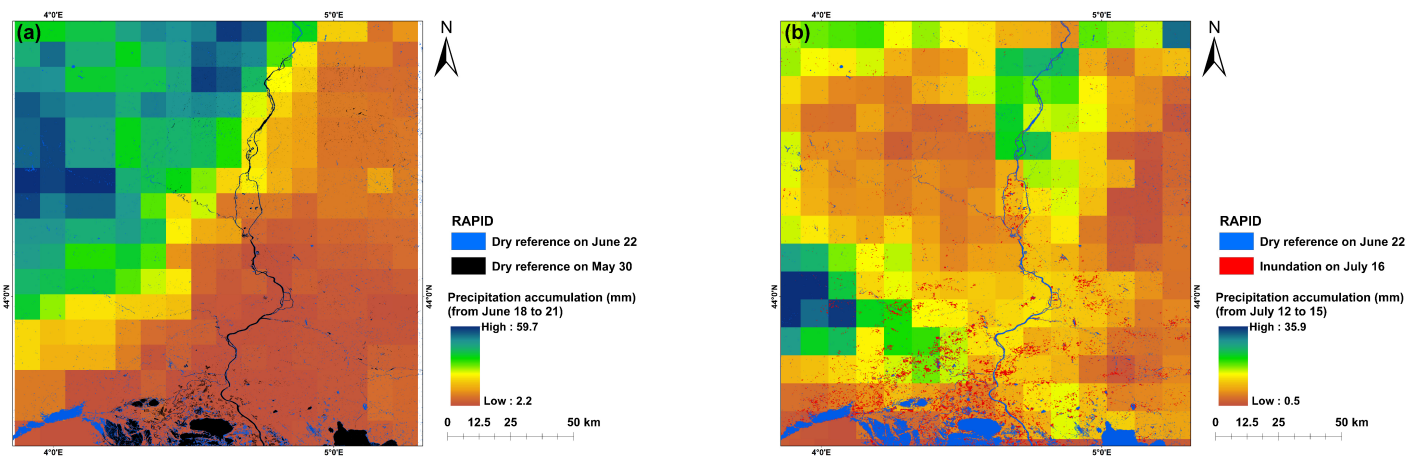


Figure 2. (a) Dry reference on May 30 and June 22 and accumulated precipitation from June 18 to 21 obtained from IMERG; (b) Dry reference on June 22 and RAPID flood map on July 16 and accumulated precipitation from July 12 to 15 obtained from IMERG;

Overall, I think the manuscript has important lessons to learn on how flooding can, and cannot, be detected from remote sensing with a nice application to a very recent and relevant event. However, I do not feel comfortable publishing results that claim widespread flooding in SE France – of a scale that would definitely have reached (inter)national media – without auxiliary arguments/data to back this up. Particularly when it does not follow, in my opinion, logically from their own results (patchy pattern) and there is a more plausible explanation available (irrigation).

Respond: Thanks to the reviewer for the confirmation of this study. As responded to the last comment, based on the additional evidence provided above, we think that irrigation in south-east France since June 15 might be the primary reason leading to the widespread flooding found in the RAPID flood map. We have addressed this in the revised manuscript as quoted in the last response

Besides, we have added caption text on Figure 2 to address the triggering reason of the inundation results over south-east France.

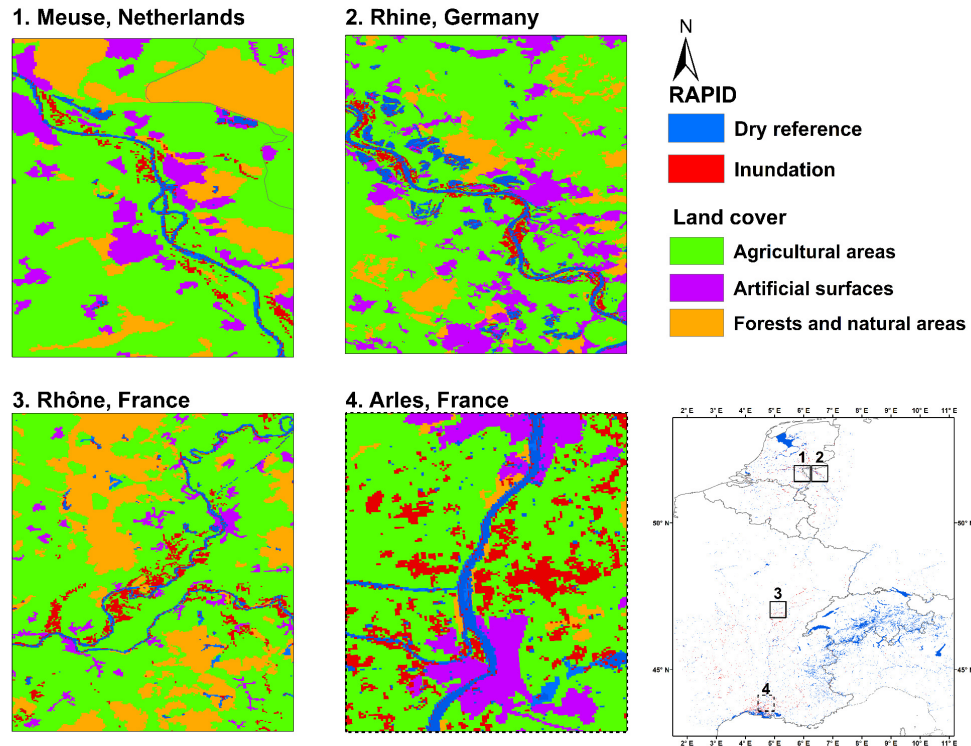


Figure 2. (b) Inundation extent over western Europe from 15th to 18th July, derived from the RAPID system.

*Note: The inundation results over south-east France, the regions in the dash rectangle, might not be caused by the flood due to the irrigation during the flooding time.*

In closing remarks, we also stated this case as one of the limitations in the current RAPID system.

From Line 175 to 177 at page 6:

*“The irrigation on croplands during the flooding period, like the case in south-east France, may cause uncertainty on RAPID inundation results. The local knowledge from the users can inform RAPID to further improve its accuracy.”*

## Respond to editor

#editor

Thank you for the submission of your revised paper “Brief communication: Western Europe flood in 2021: mapping agriculture flood exposure from SAR” to NHESS.

In the previous review round and revised manuscript, you have provided clear and convincing rebuttals and improvements to most of the points raised by the reviewers. However, one of the reviewers still has a major concern with regards the results (and the explanation of the results) for flooding in SE France. I agree completely with these concerns. The floods that your results show are of huge size, yet I cannot find any news sources or other information on this, and your results do not provide any other source to back this up. As stated by the reviewer, a flood did occur around Arlon in 2003, but showing a very different pattern. I am therefore unable to accept the manuscript for publication. I would like to give you one opportunity to revise or rebut this review, either providing strong evidence that this very large (and what would have been impactful flood) actually occurred, or providing another strong argument for a possible other mechanism (and discussion of what this means for the reliability of RAPDI), such as that suggested by the reviewer.

I also had one small point remaining. In the previous review, reviewer 1 suggested using a consistent approach for reporting numbers and their significant digits. Whilst you have partially implemented this, there are still some inconsistencies (e.g. in table 1 sometimes no value behind decimal point, sometimes one, and sometimes two). Please also amend these if you decide to submit a revised manuscript.

If you decide that you would like to submit a new version, I look forward to seeing the next version of your manuscript which I will then send out for further review to the previous reviewer (if they agree) or new reviewers.

Please be aware that this is most likely the last possibility for you to change and improve the manuscript.

Respond: We have responded to the comments from Reviewer #2 with additional results provided in the response letter. We agree with reviewer #2 that the irrigation occurred in south-east France during the flooding period could be the primary reason leading to the widespread flooding found on the RAPID flood map. Some evidence is provided to back this up, and the manuscript is revised accordingly.

Besides, we have adjusted the approach to reporting the numbers. Now the numbers in text and table are consistent with two decimal digits.