Replies to Referee #1

Interactive comment on "A Multi-sensor Data-driven methodology for all-sky Passive Microwave Inundation Retrieval" by Zeinab Takbiri, Ardeshir M. Ebtehaj, and Efi Foufoula-Georgiou

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This paper presents a new retrieval algorithm for estimating the fraction of water within a passive microwave pixel by using an archive of brightness temperature-MODIS water relationships developed from near-coincident imagery. The manuscript is well written and covers a topic of interest to the remote sensing/hydrology research community. I believe this manuscript is suitable for publication subject to reviewing the minor suggestions below:

We thank the reviewer for the positive view and constructive comments. We took all the comments seriously and incorporated them into a revised manuscript. Detailed replies follow.

I question the use of a 50% clear-sky in the VNIR data for it to be used in the algorithm. Wouldn't this influence the results (which you suggest in the discussion anyway). The Mekong region is very cloudy during the flood season. Would it be better to increase your clear-sky % to higher (which will reduce your number of observations in your dictionary, but it may improve the results)? Have you already tested this? I suggest including a short discussion on this in the paper.

The 50% threshold was selected because the MODIS sensor has a much higher resolution than the footprint of SSMI/S. Therefore, because of limited number of cloud free samples over the Mekong, we need to set a threshold to keep a certain number of SMMI/S cloudy pixels and make sure that the dictionary will not be undersampled. We believe that pixels with a small fraction of cloud cover still contain useful information about surface inundation as microwave observations are not blocked by the presence of clouds. For choosing the threshold we conducted some preliminary analyzes by randomly separating 10% of the samples from the dictionary and estimating the inundation fraction for them based on different thresholds. The analysis showed the 50% threshold, as a fair probability choice, results in minimum values of potential biases. We certainly agree that this is an important issue, which may affect the results to some extent; however, that is the best choice given the available size of the sample space. For future studies, we aim to extend the sample space to other geographical regions to be able collect enough samples with minimal or no cloud cover. We will address this issue in the revised manuscript.

You use the 3-day composite MWP products to reduce cloud cover. However, won't this reduce the accuracy of the near-coincident relationship between the brightness temperature and MODIS water product – especially when you are also looking at the sub-daily diurnal effects? I know you also average the brightness temperature over 3 days as well, however I think it would be worthwhile discussing this possible affect in the manuscript.

We thank you for this comment and acknowledge the existing uncertainties with respect to populating the dictionaries with a 3-day composite MODIS-MWP inundation dataset. We agree that this choice might affect the accuracy of the retrievals. Between the daily and a three-day averaged MODIS product, we decided to use the latter because of its lower retrieval uncertainty. MODIS-MWP daily data are very uncertain because of the shadows of terrains and clouds (Nigro et al. 2014). Typically, there are numerous missing pixels in daily products, which reduce the sample size dramatically. These errors are significantly reduced in the 3-day composite products, as it is less likely for clouds (and their shadows) to stay at the same spot for three days (Nigro et al. 2014). Because the retrievals of the presented method use a weighted average representation of the dictionary atoms, we believe that less uncertain atoms (obtained based on a 3-day MWP dataset) will provide improved estimates of inundation—compared to the more uncertain daily samples. However, a more detailed investigation is certainly needed in future studies. A brief discussion on this source of uncertainty will be added to the revised manuscript.

Minor corrections:

Once again, we would like to thank the reviewer for the provided comments. Please see our detailed response as follows:

We appreciate the reviewer's attention to minor details and the comments she/he has provided. We have incorporated all of these suggestions in our revised manuscript.

- Page 1, line 11 – should it be 'shortwave infrared'? It has been changed to shortwave infrared.

- Page 3, line 12 – change 'location' to 'locations'. It has been changed.

- Page 3, line 24 – I suggest changing…'with overlapping in spatial and time…' to 'which overlap in the spatial and time…'. Revised accordingly.

- Page 4, line 15 – change 'form' to 'from'. Fixed

- Page 4, line 20 – change '…fraction at resolution…' to '…fraction at spatial resolution…'. Revised accordingly.

- Page 5, line 23 – change ‘form’ to ‘from’. It has been changed, thanks.

- Page 6, line 11 – I suggest changing from first person (i.e. ‘let us’). - Page 10, line 2. It has been revised.

– change ‘that’ to ‘than’. It has been changed.

- Page 10, line 3 – change ‘reverse’ to ‘reversed’. Fixed.

- Page 11, line 19 – change ‘form’ to ‘from’. It has been corrected. Thanks.

Figure 2 – should it be ‘downscale’ rather than ‘upscale’ since you are reducing the spatial resolution?

In earth science, we typically use upscaling when we increase the scale and decrease resolution. We are aware that in different disciplines, this terminology might be used reversely while we associate upscaling with higher resolution.

Figure 4 caption – I assume the inundation intervals are ‘*f*’. I suggest changing the caption to ‘…five different inundation fraction intervals (*f*)…’. Incorporated.

Figure 6 – typing error in the figure ‘July-Descember’ should be ‘July-December’. Incorporated.

Reference:

Nigro, J., Slayback, D., Policelli, F. and Brakenridge, G. R.: NASA / DFO MODIS Near Real-Time (NRT) Global Flood Mapping Product Evaluation of Flood and Permanent Water Detection, 2014.