Hydrol. Earth Syst. Sci. Discuss.,
doi:10.5194/hess-2017-156-RC1, 2017

Hydrology and Earth System Sciences
Discussions
Open Access
EGU

Interactive comment on "Extending global irrigation maps – going beyond statistics" *by* Jonas Meier et al.

Anonymous Referee #1

Received and published: 5 May 2017

The authors describe the development of a global data set of irrigated land. Irrigation mapping was performed by using such a data set published before (Siebert et al., 2013), remote sensing based vegetation activity and ancillary information such as cropland masks, suitability maps and climate data (Table 1). Better knowledge where and when irrigation is used is very important for many applications, therefore attempts to reduce the present uncertainty are highly welcome. The manuscript is well written and the figures presented in it are of high quality. However, I think that the article needs to be revised and rewritten completely before the manuscript might be considered for publication in HESS:

1) Title and abstract of the manuscript show that the authors cannot put their contribution into the context of the present knowledge and completely fail to describe the scientific merit and the innovation of their research. Title and abstract suggest that

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previous attempts to map irrigation were restricted to the use of survey based land use statistics and indicate that using of remote sensing and of suitability maps represents a major innovation. This is definitely wrong. At global scale, there are three other data sets of irrigated land which were published before: Thenkabail et al. (2009) used remote sensing and ancillary information to map irrigation but they did not apply survey based land use statistics in their mapping algorithm at all. The same appears for Salmon et al. (2015). Siebert et al. (2013) is the only study that uses survey based land use statistics for mapping irrigated land but in addition they also apply a huge variety of remote sensing based national land cover products and remote sensing imagery as well. Therefore, using remote sensing products and suitability information is certainly not an innovation; it is the present standard in mapping irrigated land.

2) Developing new methods to combine a variety of different data sets for irrigation mapping is interesting from an academic perspective. However, the major challenge is to show that new methods improve present irrigation maps and reduce the uncertainty with regard to the extent and timing of irrigation. This requires in depth validation of the new data set and comparison to products published before. Unfortunately the validation described in the article is very poor and insufficient. The only data set used for validation are ground observations for Europe but the method used for validation is not appropriate. The authors compare their grid based product to point observations and it remains completely unclear how this can help to validate the accuracy of area estimates. What means an accuracy of 72% in this regard? What can we learn from this about the accuracy of the irrigated area estimate for countries like Spain or Italy where the authors detect more irrigation than in other studies before? The minimum requirement is that the authors present errors of commission and errors of omission for different countries separately. In addition they need to describe how relevant the point estimates contained in the LUCAS sample are for pixels of 1 km^2 used in the product developed by the authors.

3) Since irrigation is less relevant in Europe as compared to other continents the au-

thors should focus their validation on other regions, in particular those where the new irrigation data set differs considerably from the products published before. For sure this should be India, China and Central Asia. There is a variety of high resolution irrigation data sets available for these countries or regions which could be used as a reference. Ambika et al. (2016) should certainly be used as a reference for India while Zhu et al. (2014) could be used for China. In addition, there are inventories for the US (Ozdogan and Gutman, 2008) and Australia (http://www.agriculture.gov.au/abares/aclump/land-use/data-download) that could be used to validate the product for these regions. All these data sets were developed by using time series of high resolution remote sensing images and a lot of local background knowledge that the authors of the present article cannot have.

4) Based on the validation exercise before the authors should also discuss more critically limitations and constraints of their own approach. A variety of assumptions are made in the classification (e.g. specific thresholds) that have a big impact on the result. In addition there are limitations because of the spatial, temporal and categorical detail in the input data used by the authors. Ozdogan and Woodcock (2006), for example, describe that in parts of China and Africa even Landsat imagery with a 30 meter resolution might be to coarse for land use classification because field sizes are smaller. The coarse resolution of the imagery used in the present study and the binary (irrigation yes or no) decision tree could be one reason why in many regions the share of rainfed and irrigated fields cannot be distinguished resulting in considerable over – or underestimate of the irrigation extent. Furthermore, the suitability data used by the authors will certainly not reflect the diversity of land use patterns at the ground, in particular for regions with multiple cropping. What about permanent crops like citrus or olives? What about regions in which irrigation is mainly used for pasture (New Zealand, Australia). There are many sources of uncertainties but little information how the mapping product is impacted by these uncertainties. To my opinion it is not helpful to release products without a proper validation and uncertainty analysis. There is already a lot of confusion in the community caused by poorly validated land use products and for countries like

India just the remote sensing based estimates of irrigated land vary between 70 and 220 million hectares. Hydrological modelling has shown that even an extent of 70 million hectares would result in a drastic overuse of water resources so that it is extremely hard to believe that there should even be much more irrigated land at the ground. To conclude: what is needed is not to publish just some more figures with unknown accuracy but to develop products that are better than the products developed before and to prove this by an appropriate validation.

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