We would like to thank this reviewer for his/her comments and suggestions. We are convinced that incorporating the proposed revisions will significantly improve the quality of the paper. Specific replies to the reviewers questions and comments can be found below (in italic).

Anonymous Referee #1
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The paper describes an analysis of seasonal irrigation water requirements and crop productivity in South Asia. The region is highly populated and irrigation essential to ensure the supply of the growing population with food. The climatic conditions are very diverse with deserts in the west, very humid conditions in the east, the Himalaya Mountains in the North and fertile lowlands along the major rivers. In addition, interannual variability in precipitation is high because of the varying strength of the monsoon. Therefore, cropping patterns in this region are very complex as well with highly intensive land use enabling three or four crop harvests per year and extensive land use including fallow land on the other hand. Assessments of crop water requirements and crop productivity need to account for this diversity and complexity which is challenging. Therefore contributions such as the present manuscript are welcome and fit well to the scope of the journal. The manuscript is well written and interesting.

Thanks

However, several aspects require attention and major improvements are required before I may recommend the manuscript for publication in HESS:

Major comments: 1) While the methodology presented in this article is interesting and innovative, the analysis of the obtained results and the discussion and comparison with other research require improvement. The simulation of seasonal crop water requirements and corresponding impacts on crop yields for South Asia itself is not new. The MIRCA2000 dataset explicitly accounts for multiple cropping practices in South Asia and has been applied in many assessments and modelling studies, e.g. by Siebert and Doell (2010). The FAO provides crop calendars for the region which also account for multiple cropping and which were applied to simulate irrigation water requirement and withdrawal at daily time steps (Hoogeveen et al., 2015; Frenken and Gillet, 2012).

We acknowledge that there are other models that incorporate the effects of multi cropping on irrigation water requirements and will add references to the mentioned studies in the introduction. Both studies however have a different focus and do not show the results for seasonal irrigation demands at the level of detail as analysed in this study.
Hoogeveen et al. include multiple cropping as they incorporate national level FAO cropping calenders. They do not report on seasonal irrigation demand, but reference to their total calculations for South-Asia (910 km3 per year, table 7) will be included in the validation table (table 1).
Siebert an Doell (2010) use the same land use data (MIRCA2000) as this study and also incorporate MIRCA cropping calenders and the effect of multi cropping. They do report on global seasonal irrigation demand (fig 6), but not for the South Asian crops specifically. We will add this reference in the introduction and refer to their results for irrigation water demands and crop production for South Asia in the validation and discussion.

An advancement in the current study is certainly that it accounts for spatial patterns in the begin of the monsoon season and the corresponding Kharif cropping season. Water requirements and crop production are then presented per season to highlight the impact of the seasonal variability in climate conditions on water requirements, drought stress and corresponding crop yields. Therefore, to demonstrate the scientific merit of the current study it is essential to compare the results obtained with the improved version of the model and input data with results obtained by not explicitly accounting for multiple cropping practices in the region (versions and setup of LPJmL used in previous research).

For comparison, we will make one additional model run with the version of LPJmL as used in previous research (single cropping season and simulated sowing dates as in Biemans et al. 2013) but with the same climate forcing as used in this study. We will add the resulting daily irrigation demand in figure 5 and discuss.

2) The model was calibrated against crop yields observed during the period 2003-2008 by using three parameters: maximum LAI, maximum harvest index and a parameter scaling leaf biomass to plot level (section 2.4). Therefore it is not surprising that crop yields simulated by the model matched the observations after calibration (page 7852, lines 13-14; Figure 4). This shows that the calibration was successful but it is not a proof for the accuracy of the model itself. A validation of the model should be based on data not used for the calibration.

Reviewer is right here. We will remove this sentence which states that the calibrated crop yields match the observations as this is straightforward. We will replace this by a note marking that calibration of management factors per state enables us to simulate heterogeneity of yields between states and regions (which is illustrated in figure 4).

In addition, calibrating the model for crop yields does not mean that simulated crop water requirements are accurate as well. In particular the adjustment of the LAI parameter in the calibration for crop yield will affect crop transpiration. Consequently it can happen that a higher accuracy of simulated crop yields is on the expense of less precise results for crop water use. Therefore, more comparisons to national or subnational data for irrigation water requirements or irrigation water supply would be helpful. This could include results from model runs without the improvements made for this study to demonstrate the advancement achieved with the new version. I would expect, that in particular the estimates of the contribution of the different water sources to irrigation improved due to the model improvements presented in this study.

We will add a comparison with results of the previous model version (with single cropping and different sowing dates), see also previous comment.
Moreover, we will compare our results with subnational statistics for groundwater extractions for Indian states and with subnational estimates of irrigation consumption provided by Siebert et al (2010) in HESS (Groundwater use or irrigation – a global inventory) and discuss differences.
The reviewer is right about the effect of the maximum LAI parameter on the transpiration and irrigation water requirements. Generally, crops with high management factor will have higher yields and higher transpiration but lower soil evaporation, which we believe is realistic. We will test the effect of our calibration on the estimate of total irrigation water demand and add this to the discussion.

Specific comments:

Page 7845, line 28: please use “multiple cropping” consistently throughout the manuscript (in the current version it is sometimes multi-cropping, sometimes multiple cropping)

We will check the manuscript carefully for any inconsistent use of terms and make sure that the terms are used uniformly.

Page 7849, lines 11-14: "Crop classes in MIRCA2000 were first aggregated to the crop classes available in the LPJmL model, which are fewer (12, irrigated and non-irrigated, plus one class with "other perennial crops", vs. 26 in MIRCA) but include the most important food crops for South Asia (see Fig. 2 for distinguished crops)." => How did the authors treat crops not shown in Fig. 2, for example barley or cotton? Are water uses of these crops included in the totals reported by the authors (e.g. in Table 1) or not? If not, it is necessary to mention this, e.g. when comparing to total water uses simulated or estimated in other studies.

Crops not shown in figure 2 are included in two classes 'other crops' treated either as seasonal (e.g. potatoes) or perrenial crops (e.g. tree crops). Water uses of these crops are thereby included in the totals reported. A note that clarifies this will be added to the text.

Page 7851, line 17: "and a "summer" season from April to May." => This season is typically called Zaid season.

We will refer to 'Zaid season' in the text, but since we do not explicitly simulate the short growing Zaid crops, and crop water demand during this period is mainly from perennial crops like sugarcane and other perennial crops (see figure 5), we prefer to use the term 'summer' throughout the text and in the figures.

Page 7853, lines 4-6: "Irrigation efficiency for canal water was estimated at 37.5% in India, Bangladesh, Nepal and 30% 5 in Pakistan (Rohwer et al., 2007); efficiency of groundwater irrigation was estimated at 70% for all countries (following Gupta and Deshpande, 2004)." => This belongs to Material and methods but not to the Results section.

We will move these lines to the Material and Methods section.

Section 3.3: How do the seasonal estimates compare to those recently described in Smilovic et al. (2015)?

Smilovic et al (2015) study focusses on wet and dry rice and wheat. In their paper they present estimates of irrigated and rainfed kharif rice and rabi wheat production for all Indian states, These production figures will be compared to our results as well as the relative contribution of rainfed and irrigated fields to this production. A reference to this study will be included.

Page 7856, lines 8-9: "Incorporating seasonal cropping patterns in more detail leads to improved estimation of the timing of water demand." => This I also would expect but better would be to proof it by comparison to simulations with the previous model version.

See earlier comment. We will add the daily water demands simulated by the version and settings as used in previous research for comparison.

Page 7858, lines 7-8: "gross irrigation demand during the Rabi season is _ 30% lower than during the Kharif season, the traditional cropping season." => Shouldn't it be higher (see line 14 on the same page)?

Yes, the reviewer is right. We will correct this.

References:
Frenken K., Gillet V. (2012) Irrigation water requirement and water withdrawal by country. FAO, Rome, Italy, 263 pp., http://www.fao.org/nr/water/aquastat/water_use_agr/IrrigationWaterUse.pdf

Hoogeveen J., Faurès J. M., Peiser L., Burke J., van de Giesen N. (2015) GlobWat – a global water balance model to assess water use in irrigated agriculture. Hydrol. Earth Syst. Sci., 19, 3829-3844

Siebert S., Döll P. (2010) Quantifying blue and green virtual water contents in global crop production as well as potential production losses without irrigation. Journal of Hydrology, 384, 198-217.

Smilovic M., Gleeson T., Siebert S. (2015) The limits of increasing food production with irrigation in India. Food Security, 7, 835-856.