(comments of the referees are printed in blue, responses of authors are held in black)

Response letter to Anonymous Referee #1 (Interactive comment on Geosci. Model Dev. Discuss., 6, 645, 2013. C142–C144)

Referee #1: The model presented here is computing blue, green and gray water requirements of crops in relatively high detail. In contrast, crop yields are not computed by the model but need to be provided as input data (Table 1). The authors should discuss which consequences this setup may have on the computed water footprints. In irrigated regions crop yields often show a strong response to the performance of the water supply system. Any shortage in water supply would be reflected in crop yields (since yields are taken from the statistics) but it would not affect crop water requirements because these requirements are computed by the model without considering water availability.

Comment by authors: We agree with the general problem described by the reviewer, i.e. the simulation of water use assumes optimal water supply during crop growth while observed yields are grown under natural (non-optimal) conditions. However, this is a general methodological problem of the water footprint approach, rather than that of the SPARE:WATER tool. According to water footprint manual by Hoekstra (2011), the crop water requirement is defined as "the total water needed for evapotranspiration, from planting to harvest for a given crop in a specific climate regime, when adequate soil water is maintained by rainfall and/or irrigation so that it does not limit plant growth and crop yield". Nevertheless, to account for this important point of discussion we included the following section in our conclusions:

> *"SPARE:WATER estimates crop water footprint on the basis of simulated optimal crop water requirements and observed crop yields from statistics. This is in accordance with the current water footprint manual (Hoekstra et al., 2011), but has a methodological limitation. Crop yields in irrigation agriculture often show a strong response to the performance of the water supply system. Any shortage in water supply is likely to be reflected in crop yields of the real world. As SPARE:WATER estimates optimal crop water requirements without considering yields, low yields can substantially increase the water footprint. For this reason adequate crop yield data are absolutely essential for the estimation of correct water footprints."*

Referee #1: In the introduction and the discussion section authors describe other models used for similar purposes and explain or discuss differences to the model presented here. Such a comparison is required and highly appreciated. However, I miss a reference to FAO AQUACROP in this comparison because FAO AQUACROP is likely the model which is most similar to the model presented by the authors.

Comment by authors: We agree with the referee that AQUACROP has to be included in the comparison of models. The following information has therefore been included in the manuscript:

> "*Alternatively, yields are predicted along with crop water requirements. The FAO model AquaCrop (Raes et al., 2009; Steduto et al., 2009) supports decision making and addresses question such as deficit or supplementary irrigation as well as crop growth and yield response to water stress."*

Referee #1: In addition, it seems that the authors confuse model extent and model resolution when comparing their model to global models. The global models mentioned by the authors (H08, GCWM, WFPN) simulate crop yields and crop water requirements at a spatial resolution of 5 arc minutes at global scale. It's therefore a matter of the presentation of results whether crop specific water requirements are made available for each single country and territory but it's certainly not an issue of missing spatial detail as suggested by the authors (e.g. on pages 663 and 664). It is also very obvious that the water footprint computed for Saudi Arabia will differ a lot from global averages, mainly because of different climate and different crop management. Therefore I don't see a value in comparisons like the one presented in Figure 7.

Comment by authors: We agree with the referee that the comparison presented in Figure 7 could be misunderstood because these models differ in extent and resolution. The figure has been deleted. A revised figure 7 now includes data of this study and the crop water footprint provided by Mekonnen and Hoekstra (2010).

Referee #1: The authors apply their model for Saudi Arabia to demonstrate the capabilities and to compare the model output to results obtained from other models. I miss a discussion on how a successful application of the model in Saudi Arabia can suggest that the model can be used for other countries as well. In many aspects Saudi Arabia is a very specific case. Agriculture is completely relying on irrigation, climate is extremely arid and irrigation water is mainly withdrawn from fossil aquifers. I would highly appreciate some guidelines on how to adapt the model and the required input data when applying the model in other regions where irrigation is used supplementary, salinization is caused by high groundwater tables and water logging instead of saline irrigation water or regions where winter rains wash out the salt accumulated in the soil by irrigation in the summer season (e.g. the Mediterranean region).

Comment by authors: The crop water simulation model of SPARE:WATER is based on the guidelines proposed by Allen at al. (1998) and the associated CropWat modeling approach. The general model structure and model philosophy would allow the inclusion of rising groundwater or water logging through high salt concentrations. But such changes would require the modification of the software itself, despite requiring comprehensive model input data on soil physical parameters. For this reason the applicability of the current SPARE:WATER version is limit to environments where such effects can be neglected. Nevertheless, it will be important in future to account for such effects in cases where these processes are relevant. We added the following section to the conclusions to discuss this:

> *"The current version of SPARE:WATER is focusing on irrigation agriculture that is primarily relying on blue water sources and where precipitation is very limited. If irrigation is used supplementary and if soil salinization is caused by high groundwater tables and water logging rather than saline irrigation water, these additional processes need to be considered in SPARE:WATER. The same is true for climatic conditions where precipitation outside the vegetation period leads wash out of salts from the root zone, such as winter rains in Mediterranean climates. Future users should consider this and add additional functionality to SPARE:WATER which is highly appreciated and which is supported by the open source code of the model."*