**Hydrology and
Earth System
Sciences
Discussions**

Interactive comment on "The green, blue and grey water footprint of crops and derived crop products" *by* M. M. Mekonnen and A. Y. Hoekstra

Anonymous Referee #1

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General comments:

This paper about global water consumption ('footprints') in agriculture provides information about these footprints at a level of detail not achieved before (i.e. 5 arc-min resolution, >160 crops, and differentiation into 'blue', 'green' and 'grey'). It is a rather descriptive, proof-of-concept study that presents a lot of data without an in-depth discussion of their relevance/meaning. While this could be somewhat improved in a revised version (e.g. by trying to explain why footprints differ strongly among products and regions), it is not a major flaw, especially since the conclusions address the most important uncertainties related to the presented results. However, some more detail is required, and the terminology should be reflected; see following comments.

Specific comments:

It is unclear why the grey footprint is additive to the blue and green footprint. To my understanding, the polluted water captured by the grey footprint is the blue water, isn't it? Please clarify, and say a bit more about this conceptual problem of bringing together blue/green and grey footprint. In general, the grey water footprint is calculated in a very static manner (constant of fertilizer application, obviously not diluted along the river channel), which renders it more or less meaningless, thus in my opinion, the paper could go without it. If I am not correct, please clarify the pros and cons of your concept.

I think using the term "footprint" in the context of this paper is neither correct nor intuitive. What you are actually presenting is the water consumption (evapotranspiration) of different products, whereas to my knowledge a footprint needs to be put into the context of a country or individual person (e.g. water consumption per capita), and it needs to also consider the water consumption at locations other than the location of the crop's production. I note that you also computed footprints per calorie, but this is not intuitive either. This conceptual difference should be clarified and/or discussed, as well as the fact that you did not consider virtual water trade.

End of Introduction and Table 8: I realize that there is a concurrent paper in the same journal about global blue and green water footprints, which apparently requires some attention here (Fader et al., Discussion Paper, http://www.hydrol-earth-syst-sci-discuss.net/8/483/2011/hessd-8-483-2011.html).

Methods: More detail is required in the description of how you computed the two 'scenarios' with and without irrigation: Did you change the values of K_c and K_s? Don't you overestimate the green water contribution this way, as in the absence of any irrigation yields would in many cases be much lower than suggested by the difference between the two scenarios? Also, what does it mean, "maximum yield values" (p. 769 line 18)? And, do crop growth / yields and water balance (soil moisture, evapotranspiration) interact in your model, and how is crop growth actually modeled? Is the nitrogen application considered in the computation of crop growth? Please also say a few words (p. 770) about the methods by Hoekstra (2009) and Gerbens-Leenens (2009), which

seem to be important for the present paper.

Data: How did you determine the areas covered for the production of bioenergy? The description of Section 4.6: The interpretation of why water footprints are lower in rainfed agriculture is rather awkward; are you sure?

p. 780: Isn't there an extra category in Aquastat for domestic and industrial water use (i.e. I presume that these are _not_ included in the agricultural statistics).

page 782: I would not say that in (semi)arid regions it is "almost impossible" to increase yields without addition of blue water; please note soil conservation methods etc.

Figs. 4-8: Using R2 is not meaningful in most of these plots, because one would expect a high correlation due to the large differences in the area of countries (i.e. any model would produce low/high footprints in small/large countries). Please also remove the y equations and the trendline, as your intention is not to provide a regression analysis. Fig. 7: Are irrigation efficiencies considered in your data for this plot?

Minor technical comments:

page 768 line 14/15: " ... is a dimensionless ... soil water": Redundant, has been said before. The same applies to the first lines of page 770 ("The grey water footprint ... water bodies."

page 769 line 25: green and blue water _use_ or _consumption_? Same page, line 9: Please mention that the "maximum acceptable concentration" is explained later. Why not merge the Methods and Data sections? This would improve the text flow.

page 781: "importance of rain", this is a clumsy term, please reformulate.

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