

## ***Interactive comment on “A global and high-resolution assessment of the green, blue and grey water footprint of wheat” by M. M. Mekonnen and A. Y. Hoekstra***

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The paper describes the global modeling of the water footprint of wheat. The manuscript is well written, new and original and is certainly of interest for a large community. The content of the paper fits very well to the scope of the journal. I would therefore recommend to consider it for publication in HESS. However, I would like to see some comments and remarks addressed in the final version of the paper:

General comments: 1) The concept of grey water is not convincing to me. Farmers do not apply any additional water in order to assimilate fertilizers, therefore gray water

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should better be assumed to be a fraction of green or blue water. High nitrate or ammonia concentrations within the active root zone are not harmful to crops. In contrast, high nitrate concentrations in drinking water and water bodies are harmful in general but cannot be simulated by using the model presented here because it does not account for denitrification and dilution processes. Maybe that I understood this wrong but if so, the authors should describe how they simulated the nitrate concentration in groundwater and surface water bodies.

2) International virtual water flows were calculated by multiplying trade volumes by their respective water footprint (page 2507, lines 5-7). However, virtual water flows should link producers and consumers of wheat which might be different from trade partners. How did the authors consider re-exports of wheat or wheat products? For example, several countries in tropical regions like Guinea, Cote d'Ivoire, El Salvador or the Dominican Republic are exporters of wheat or wheat products although wheat is not cultivated in these countries. Therefore these flows are very likely just re-exports. How was the water footprint of these quantities of wheat computed and between which countries was then the related virtual water flow assumed to take place? The authors computed, for example, net blue virtual water exports of 21 Mm<sup>3</sup>/yr for Saudi Arabia (page 2511, line 22), although according to FAOSTAT imports of wheat and wheat products are more than 15 times larger than exports. Therefore it may even be that net blue virtual water exports are 0 for Saudi Arabia (when all exported wheat products are re-exports to third countries, e.g. the same wheat is imported from the US and exported afterward to Iraq).

3) Runoff, actual evapotranspiration and therefore also green and blue water use were computed based on a simplified soil water balance. What happened outside the wheat growing season with the soil moisture content and how was the soil moisture content initialized at the begin of the next growing season?

Specific comments: 4) pages 2510 + 2511: “Although, on average, wheat yields are 30% higher in irrigated fields, the water footprint of wheat from irrigated lands is higher

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than in the case of rain-fed lands. The reason is that, although yields are higher under irrigation, water consumption (evapotranspiration) is higher as well." The reason seems more that grey water is considered as an additional water use. The sum of green + blue water footprints per ton of wheat is smaller for irrigated than for rainfed lands (Table 3).

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