Response to Interactive comment on "A global and high-resolution assessment of the green, blue and grey water footprint of wheat"

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Response to Hong Yang:

#1. We accept the comment and will mention the differences in periods considered as one explanatory factor behind the different outcomes of the various studies. In addition, the revised paper will include more discussion on the global water saving, the difference in the green/blue water footprint among countries and its implication in the sustainability of freshwater use.

#2. We agree that the grey water is not gone from the system as the green and blue water will through evapotranspiration. While the green and blue water footprints are the volume of water actually consumed ("lost" through evapotranspiration), the grey water is the volume of water needed for the assimilation of polluted water. Both the consumed green/blue water footprint and the grey water footprint are water appropriated by human being for the production of wheat. Pollution by different chemicals including fertilizers and other agrochemicals is one of the key environmental problems facing humanity today and it seriously degrades aquatic ecosystems and makes the water unsuitable not only for human drinking but also for use in industry, agriculture, recreation and other purposes (Carpenter et al., 1998; Schwarzenbach et al., 2006). In this sense, the grey water footprint adds information on how humans appropriate the available fresh water resources. Rivers are used as both a source and a sink. The blue water footprint shows the extent to which a river is used as a source; the grey water footprint shows the extent to which a river is used as a sink. The grey water footprint, expressed as the dilution water requirement, has been recognized earlier by for example Postel et al. (1996) and Chapagain et al. (2006).

Specific comments:

p.2502, lines 15-17. 'For trading purposes, wheat is classified into distinct categories....'. I assume that water footprint of different wheat varieties differ. It is not clear if the authors considered these differences in their calculation of water footprint.

Response: The variability of growing characteristics and crop parameters between spring and winter wheat result in different water footprint for two varieties. The difference between the spring and winter wheat is considered in the current study by taking the different crop parameters such as Kc's, rooting depth and the length of growing period. We do not make a difference in the study between different varieties of winter wheat or different varieties of spring wheat. We will improve the text to avoid the apparent confusion created by the current text.

p.2509-2510. The text of Section 4 contains mainly the numbers estimated. It mostly repeats what are reported in Tables and Figures in the section. I suggest the authors to drop the report of numbers, but provide supplementary information in the text. Also the numbers in Table 3 can be easily (and should be) incorporated into Table 1.

Response: We accept the comment and will include more discussion points in the revised paper. Table 3 can partly be incorporated into Table 1, but the added value of Table 3 is that it also shows yields for rainfed versus irrigated agriculture.

p.2514, lines 15-18. 'If we assume that wheat export from the USA comes from the different states proportional to their production....'. This assumption cannot be sustained because most states do not produce sufficient wheat for self-consumption. They actually import wheat from other states (or countries). Suppose a state's production is 10% of the national total but is only able to meet 80 % of its consumption, assigning a weight of 10% to this state in the calculation of virtual water export is not appropriate.

Response: The comment is valid. It would be more appropriate to assume that wheat export from the USA comes from the different states proportional to their production surplus (regional production minus consumption). Probably the contribution of the Ogallala states to USA's production surplus is higher than its contribution to USA's total production, since the region is known as USA's breadbasket. In this case we have underestimated the use of water in the region for making wheat for export to other countries. We will check the numbers and modify our estimate accordingly.

p.2513-2516. Section 7. This whole section is mostly compiled with numbers. The text basically repeats the same information as shown in Tables and Figures. The authors should provide some analysis of the impacts of the water use in wheat production on the local water resources and environment in the case study regions.

Response: We will include more discussion points in the revised paper, particularly we will highlight what insights on the international dimension of water resources use may imply for conventional water policy (which focuses on regional regulation rather than international).

References:

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Chapagain, A.K., Hoekstra, A.Y., Savenije, H.H.G., and Gautam, R.: The water footprint of cotton consumption: an assessment of the impact of worldwide consumption of cotton products on the water resources in the cotton producing countries, Ecol. Econ. 60(1), 186–203, 2006.

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