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Hydrology and Earth System Sciences Discussions

Interactive comment on "Internal and external green-blue agricultural water footprints of nations, and related water and land savings through trade" *by* M. Fader et al.

Anonymous Referee #3

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Fader and coauthors conducted a hydro-agronomical simulation globally and estimated virtual water contents, internal/external water footprints, and water savings/losses comprehensively. Notably, they mentioned that they first estimated "virtual land flow". They intensively compared their results with earlier studies.

Many of the authors' findings can be seen elsewhere, at least qualitatively. For example, quantitative estimation of virtual water contents and water footprints has been reported in dozens of scientific journals. All of them pointed out similar geographical patterns of virtual water exports and imports. Separating virtual water into blue (evapotranspiration originated from irrigation) and green (that from precipitation) is a relatively

new research topic, but several papers have been published on it. “Virtual land” seems to be firstly appeared in this paper, but the concept is rather simplistic and I couldn’t find clear implications in this manuscript. If the authors do not agree with these points, I strongly suggest the authors emphasize what are newly found in this study.

Nonetheless, I believe this paper is considered for publication, because of two reasons. First, the authors used the LPJmL model in this study. LPJmL is one of state-of-the-art global hydrological models, incorporating advanced sub-models of human activities, and it has been intensively tested through a number of applications by active research groups. Therefore, the results of LPJmL will be of interest to the large scale hydrological modeling community. Second, both “virtual water” and “virtual land” is literally virtual (i.e. quite difficult to physically measure if not impossible), and numerical simulation is the only practical way to estimate them. To increase confidence in scientific understanding, we need to increase the number of models and simulations.

The text is fairly easy to read. However, the current form requires readers’ good memory to remember dozens of acronyms, good knowledge of earlier works to understand the meaning of comparison between this study and earlier ones, and good patience to read through long text. Possibly, the authors could improve readability of this paper by:

- adding nomenclature of acronyms

- adding a table which summarizes methodology of earlier studies

- moving some of the contents to appendices, particularly comparison between this study and earlier ones.

Specific comments

Page 484, line 24, “Thus, countries with high levels of per capita water consumption affect mainly the water situation in their own country”: I couldn’t clearly understand what the authors meant here. What is “the water situation in their own country”?

Page 486, line 21, “probably overestimating the production in these regions and thus

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underestimating VWC": I couldn't understand how the authors concluded this.

Page 496, line 25, "Due to the higher spatial resolution of our calculations, we believe our estimates to be more precise": This is not obvious. There is no relationship between spatial resolution itself and the precision of simulation.

Page 496, line 27, "The agreement between our results and Hanasaki et al.'s (2010) resuts . . .is mostly very good" : How did the authors judge that the agreement was "very good"? The authors also mentioned that their results showed also "good agreement" with Mekonen and Hoekstra (2010) and Siebert and Döll (2010). Does it mean all of these studies reported very similar virtual water content (VWC) of major crops?

Page 500, line 9, "the blue water consumption (BE) in the LPJmL-based study by Rost et al. (2008) (1258km3), mainly because we considered only part of the cropland and also because that study was based on different land use dataset with some differences in parameterizations" : I couldn't understand why this large discrepancy appeared in global total blue water estimation between this study (449 km3) and Rost et al. (1258 km3). Both studies used LPJmL and calculated similar crops (Chapter 2.1). I would like to suggest the authors add some clear quantitative explanation here.

Page 505, line 20, "This study is the first to make a process-detailed and spatially explicit differentiation of blue and green water in virtual water contents, virtual water flows and both country internal and external water footprints for the majority (through not all) of the world's crop types": As the authors mentioned in Introduction, Aldaya et al. (2010), Hanasaki et al. (2010), and others have already estimated them, if not all. I would like to suggest the authors write here with care, what is truly shown "first".

Page 506, line 8, "In general, we think that the LPJmL model used here . . . can better account for effects of climate variability on crop production, yields and virtual water contents than stand-alone hydrological models of models that use prescribed crop calendars" : This is true only if all of the parameters of LPJmL are properly given to the entire study domain. If the parameters are wrong, the performance of complex process

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models can fall below simplistic conceptual models.

Technical corrections

Page 502, line 11: “WPFs” reads “WFPs”.

Page 505, line 15: “patters” reads “patterns”

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 8, 483, 2011.