

## ***Interactive comment on “Virtual water trade flows and savings under climate change” by M. Konar et al.***

### **Anonymous Referee #1**

Received and published: 16 January 2013

#### General comments:

This paper deals with a very important question: how climate change may affect virtual water trade. This topic, if well analyzed and interpreted, has the potential of taking virtual water research a step forward and giving interesting hints about adaptation options. While the topic of the manuscript fits well within the Journal's scope, the manuscript seems to have been written in a hurry: formulations have to be strongly improved, some parts are repeated over and over again, terminology is not consistent across the paper, there is no discussion provided, very important sections (such as shortcomings of the models used) are completely missing, methodology is poorly described and conclusions are oversimplified. Also, the second important crop by harvested area globally, maize, is not considered in this study and it is not even mentioned why.

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#### Specific comments

##### Introduction:

You may give some examples or quantities: which regions are becoming more/less suitable? How much water does international trade save?

You may want to shortly mention the crops considered and the models used

There is little connection between the paragraphs, this is why it is hard to see the common thread of this section. Consider improving this point while presenting the coming sections in an interesting, attractive way.

##### Methods

Why do you consider only three crops and even leave maize out of the analysis?

P71 L 24 and elsewhere: Why do you use the phrase “yield shocks” instead of yield changes? That would certainly represent better what you mean, since changes are positive and negative.

P 72 L 13-19 This assumption would require that you consider adaptation costs (including those for technology development) in GTAP for the medium and high-yield scenarios.

P 72 L 23 How realistic is the relative price change from GTAP taking into account that you keep population and income fixed?

Section 2.2. How does H08 deal with irrigation? You mention that you used Siebert 2005 for irrigation areas. Still, do you average irrigated and non-irrigated areas to obtain national VWC? How? Do you have coexistence of both in a grid-cell? Which is the method used to calculate water irrigation requirements and evapotranspiration?

Section 2.2. At which spatial and temporal resolution does H08 work?

Section 2.2. How does H08 deal with CO<sub>2</sub>-fertilization?

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Equation (1): I first thought you correct VWC calculated with H08 for the future with a correction factor  $(1/(1+r))$ . But then I saw that the index of Y is "Baseline" instead of "GCM". Please explain what this (ETGCM/YBaseline) represents. For me it does not make any sense to calculate VWC with current yields and evapotranspiration under climate change, since they are strongly coupled in a biophysical way.

Equation (1): the correction factor  $1/(1+r)$  follows an exponential function. Is it a fit from H08 results? Or did you adopt this function based on literature? Does it make sense, and if yes, why?

What is the difference between CT and T? And why is CT indexed by scenario and T is not? Compare equation (2) and (3) and clarify.

#### Results

Consider explaining or discussing the variations in results coming from different GCMs. Also comparing to variations coming from different productivity scenarios.

P77 L1-5 Why?

P77 L 22 I do not see that what you explained let you conclude that changes disproportionately impact their export prospects. Please clarify.

#### Conclusions:

Page 82 "It would be advantageous to reduce..." Why? Do we really need high water-efficiency in water-rich regions? Or in regions where opportunity costs are low? Is there a relation between water-efficiency and sustainability of the production?

Page 82. Your implications concerning trade liberalization and cut of subsidies are very simplistic and I would even say unfounded. Please consider adding arguments, citations and looking at that from a broader perspective, referring also to, for example, consequences for sustainability, deforestation and poverty.

Missing: I strongly recommend adding following sections: a) Discussion (shortcomings

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of the models used, influence of assumptions, etc.), b) Evaluation/validation of yields and VWC under climate change with estimates from other authors.

#### Technical comments:

##### Abstract:

Crops considered should be mentioned.

L 8 and elsewhere: Be consistent with the terminology relating water productivity (virtual water content, water-use efficiency or crop water use).

L11: If I understood right you do not use the H08 model to "transform crop flows into virtual water flows", but you calculate this in post-processing by multiplying VWC by trade volumes. If I am right, please correct this sentence.

L 12: Why does total volume of virtual water trade goes down? Please clarify.

L14: It is unclear what are you referring to with "climate impact scenarios". Please clarify or use another formulation.

L15: it may be a good idea to shortly clarify what you mean by "more water-efficient structure".

##### Introduction:

P68 L 20 cacophony through "changing climate" 2 times

P69 L5: consider adding a short clarification on how international trade may exacerbate the negative consequences of climate change.

P69 L14: reference missing (to my knowledge linking virtual water trade to food and water security is a difficult task and has not been made yet. Assuming for example that imports improve food security would be too simple)

##### Methods:

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P70 L21 “of each national economy”. Is it so? Or do you refer to the regions described in Table 1? In that case “some national economies” or something similar would be a better formulation.

P70 L23 consider clarifying what “factor market clearing prices” are, since only economists are familiar with this terminology.

P71 typo “constant”

P 72 L3-4: you already explained this in P 71 L 8-9.

P 72 L 28. This has to be a weighted average, but by what? area, production?

#### Results

When you refer to Fig.x,a-c, you use lowercase in the text, but in the figures you use uppercase. Be consistent.

You do not need to define abbreviations that you already defined in the methods.

P76 L 10. Formulation may be confusing, since “climate scenario” may be understood as the outputs of the GCMs. But you do use 14 GCMs, not only one. Please clarify, maybe replacing “climate scenario” by “emission scenario”.

P 77 L6-7 “decreased planting times”? You mean earlier sowing date or shorter growing periods?

Section 3.4. “Large values of VWC indicate ...” You already explained that a few times. . .

P80 last paragraph and Page 81 first paragraph. This is discussion, not really material for the result section.

#### Tables and figures

Tables 1, 2 and 4 may be moved to the appendix (they are not needed to understand the results).

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Table 1: typo in number 92.

Table 2: consider alphabetical order.

Table 3 may be moved to the appendix since most of the information there is depicted in Fig. 1. Typo in last line.

It would be a very good idea to convert some tables (at least Table 7) in maps with arrows like the ones in Fig. 5.

Table 8 and 9 may be moved to the appendix since Fig. 5 contains most of the information.

Fig. 1 What do grey colors mean? Consider changing colors (for example giving values around zero some “low-profile”-color). Caption: “shows” instead of “show” (5 times). Add units to the legend (%).

Fig. 2 VWC dimensionless? Please explain. And which red stars? I can't see them (in other graphics I do see them). Consider harmonizing y-axes (if possible) to simplify comparison.

Fig. 5 Consider harmonizing the legend if the range of values allows for it. Please add units to the legend. What do the grey colors in the first column mean? You actually do not need black and red arrows since you have different columns for losses and savings.

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 67, 2013.

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