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Interactive comment on "HESS Opinions: A Planetary Boundary on Freshwater Use is Misleading" *by* Maik Heistermann

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The advantage of starting late in the discussion is that one can benefit from the exchanges that have already taken place between author and reviewers. With regular papers, it is maybe not desirable to read the other reviews before writing one's own, but in the discussion of an opinion paper, such interaction is very valuable, I think.

First of all, I would like to complement the author on a well-argued opinion. The author makes a convincing case when he states that there is not really a planetary boundary for water use. For a regime shift to take place, there should be a clear non-linear feedback mechanism that can shift the system to another (non-desirable) system state; for instance large-scale desertification, or maybe large-scale flooding. The author fails to see such a mechanism, particularly not when we merely consider that water is man-

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aged within river basins. And why would the poor management in one river basin have global impact, or lead to some domino effect that tips the scale? I can follow this argument, but then the author misses an important feedback mechanism.

The global water resources are fed by moisture that is transported from the oceans to the land through the atmosphere. Indeed this moisture flux is not likely to be affected by our water use, although people like Makarieva and Gorskov (2007) (http://www.hydrol-earth-syst-sci.net/11/1013/2007/) state otherwise (and they may have a point). But more important is that this flux, as it travels over land, is influenced by our land use. Precipitation drains the flux, but evaporation from land (seen by many as a loss of water, which it is not) replenishes the moisture content of the atmosphere and sustains rainfall occurring downwind. Just like in the economy where economic activity has a multiplier effect on the GDP, the evaporation has a multiplier effect on the terrestrial precipitation. As was shown by Van der Ent et al. (2010), large parts of the world rely for 80% or more on moisture that has been recycled (sometimes several times) by evaporation from land. Most of China, large parts of Africa and South America rely for more than 80% on recycled moisture. Land use change thus has an impact that goes beyond the river basin boundary and has a global impact, particularly if such land-use change is the result of a policy to turn forest into crop land, or to overstock marginal grass lands. Although this is not the same as merely water use, it is clearly a change in water using activity that could have irreversible effects at global scale. And to strengthen the argument, Van der Ent et al. (2010) merely looked at the moisture content in the atmosphere. They did not consider the change in atmospheric circulation patterns that could result from changes in the energy budget associated to land use change

So I agree that it is hard to see a planetary boundary in water consumption itself, as long as this negative feedback mechanism is missing. And also that it is too simple to just put a cap on water use. But land use change definitely can have a negative feedback on terrestrial precipitation, and the impact of local changes can be much

more far reaching than is suggested purely by water withdrawal.

As an aside, I don't agree with anonymous referee#1, who found the author's language too colloquial. I am not at all sure if more formal language would help to make the message clearer. Please feel free to use the clear and well readable language used in this article. Particularly in an opinion paper such language is welcomed.

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