

## ***Interactive comment on “Modelling global water stress of the recent past: on the relative importance of trends in water demand and climate variability” by Y. Wada et al.***

### **Anonymous Referee #1**

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This is a mostly well-written, comprehensive paper that aims to understand trends in global and regional water scarcity over the past decades and especially to estimate the contributions of changing water demand and changing climate (droughts in particular) to these trends. I think this is a worthwhile study and it is in principle well done, though the authors should consider some improvements and clarifications, as detailed in the following.

Major comments: 1) Your analysis strongly focuses on the grid cell scale, which implies that all the water needed by the population is available in the very area (the grid cell)

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where they live, which is not necessarily the case. Thus, the stress may be overestimated in some regions, e.g. where water is transferred over distances larger than a grid cell. Please discuss this issue (though it may well be that your indicator is not strongly affected by this, since you explicitly consider the actual water extraction). You may even show water stress maps with values aggregated to countries (especially since you discuss country averages in the second part). Please also discuss the fact that you consider the blue water only, which may bias the estimate as well. In addition, it is a bit problematic that you do not consider non-renewable water resources in the indicator (thus underestimate local stress); indeed, the water stress indicator could adopt values larger than 1 if this was considered, which if shown would highlight areas where non-renewable/non-sustainable water resources are being consumed. This needs to be justified and defined more clearly. And finally, livestock water demand is defined quite conservatively, as you only consider drinking water (while e.g. field where feed is produced may be irrigated); please emphasise this. 2) You show trends in water stress including effects of demand from all sectors. This is fine, but can you say more about the individual contributions of industry, agriculture and households to these trends, in the different regions? In addition, and more importantly, I am a bit worried about your definition of “drought”, which you mix up with moderate/high “water stress” as quantified by WSI. These phenomena (high abstraction vs. drought) may, however, not always be congruent. Please discuss this, and be careful in comparisons with other studies like the one from Stahl et al. (2009) who may have defined drought totally differently. Moreover, it is unclear methodologically how you come to the often-stated conclusion that climate often has onset (meteorological) droughts (which then have been intensified by high water withdrawal)? 3) Some sections and tables could be left out, shortened, or moved to an appendix, as the methods part is very long and many many numbers are provided, so that the main messages are partly hidden in loads of other material. Section 2.6.1, 2.6.2, 3.2 and tables 1 to 4 (showing results from other studies for the present) and 7 (largely covered by Fig. 3) are such candidates. Figures 3 and 7 are also not need, as it would be more informative to see whether the trends that you com-

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puted agree with other studies, not just the values around year 2000. I suspect that such validation plots are already shown in your earlier papers(?).

Minor (editorial) comments: 1) The entire text should be checked for typos and grammatical errors. For example: “account for” not “account”; “Mexico is characterized” not “Mexico characterized” . . . 2) Abstract: Please mention what water stress indicator you used. 3) I do not see mentioning of Fig. 1 in the text, please check. 4) Section 2.3.2: Explain what method was used for computing potential and actual evapotranspiration (in relation to crop growth and phenology). 5) p. 7409: Why do you focus on Japan here? Are those values used for other industrialised countries as well? 6) p. 7414: “irrigation gift”? p. 7415, groundwater abstraction is not just “somewhat” uncertain but highly uncertain. 7) p. 7420: Why did inclusion of expansion of irrigated areas produce larger numbers than Kummu et al.? 8) End of section 3.5: You should mention that estimates of blue water use are uncertain in regions such as the Sahel, which may compromise robust detection of trends and their causes. 9) Fig. 11: The temporal developments are hard to depict. Better show annual or seasonal averages, or running means (to highlight droughts)?

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