

Interactive comment on “Recasting catchment water balance for water allocation between human and environmental purposes” by S. Zhou et al.

Anonymous Referee #3

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General comments: Overall quality of the paper is moderate. The topic of water allocation for ecosystem services is highly relevant to the scope of HESS; the Murray-Darling basin an appropriate case study. The authors' technique in modifying a tested hydrologic tool and applying it to evaluate ecosystem water needs is original and thought-provoking. However, the authors place unbalanced focus on terrestrial portions of the river basin, neglecting water needs of the rivers themselves. Structuring of the water balance retains a fundamental flaw in human thinking about ecosystem needs for water. In the authors' rendering of water accounting, all water needs are accounted for, leaving aquatic ecosystem requirements as a “whatever is left” term. This conceptualization supports outdated and disregarded ideas that water flowing in the river to the sea is ‘wasted’ or that human uses of water may continue unabated until all flows are

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appropriated. The authors thus demonstrate little understanding of ecosystem services provided by aquatic ecosystems and the role of flow regime in aquatic ecosystem function, both of which should ideally be addressed in their framework. The partitioning of ET into agriculture, pasture, and native vegetation is interesting, however it is unclear what the analysis of ecological vs. social ET/GPP provides that a land use analysis could not have provided. The key messages/contribution of the paper could be more effectively packaged by restructuring the paper slightly. The language and grammar are largely comprehensible, however, many errors in tense and syntax exist. Thorough copy-editing by a native speaker is necessary to eliminate all such errors.

Specific comments: 1. Abstract must clarify that the four time periods of the MDB case study are obtained through the recast water balance and are an analytical outcome of the paper. As it reads now, it is understood that the authors divided time according to basin management and analyzed each period. 2. Description of results and significance is lacking in abstract. For example, “The recast water balance provided new understandings of the water and land dynamics between societal and ecological systems in the MDB, and it highlighted the experiences and lessons of catchment water management in the MDB over the last more than 100 years.” Specifically, which new understandings came from the analysis? What experiences and lessons were elucidated? 3. Rather than repeatedly framing the technique as the “recast water balance”, it may be more effective to give the technique a more descriptive name. For instance the “socio-hydrology water balance” or the “human-ecosystems water balance”? Something that others could refer to in their future work. This new nomenclature should appear in the title. 4. Introduction needs more specific information about why the traditional water balance approach cannot support sharing of water between social and ecosystem needs. What specifically are the shortcomings? 5. Needs mention of ecosystem services related to freshwater. How specifically is the traditional water-balance able/not able to support ecosystem services? 6. Discussion of IRBM needs updating. If there is a reason the authors choose to retain focus to IRBM it should be stated, with discussion of how IWRM and IRBM are compatible/different. 7. Objective statement (lines

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22-23, pg. 914), specifically how will this study advance socio-hydrology? 8. The paper could be more effective with a few simple restructures. I suggest describing theory first, followed by a case study example. First outline segregation of the water balance, moving description of the MDB to later in the paper. 9. The authors' water balance does not account for reservoir storage. dS/dt is defined solely as soil water storage. This is valid in natural river basins, but as the authors' proposal is of the most utility in regulated basins, they should perhaps propose a term for surface storage, particularly to make their model more applicable to sub-annual analyses. Same comment could be made for storage in snowpack. 10. Some terms in classified as ET in the proposed water balance are not intuitive and need further explanation, for instance ETH. Why is water used for households classified as ET? 11. The authors claim their proposed water balance is an improved management tool to balance water needs of humans vs. ecosystem needs. However, their structuring of the water balance retains a fundamental flaw in human thinking about ecosystem needs for water. In the authors' rendering of water accounting, all water needs are accounted for, leaving aquatic ecosystem requirements as a "whatever is left" term. Page 917, line 11 " . . .the remaining surface runoff is retained for ecosystem purposes or flows into the sea." This conceptualization supports outdated and disregarded ideas that water flowing in the river to the sea is 'wasted' or that human uses of water may continue unabated until all flows are appropriated. The proposed places unbalanced emphasis on terrestrial water needs while ignoring aquatic needs. The authors thus demonstrate little understanding of ecosystem services provided by aquatic ecosystems and the role of flow regime in aquatic ecosystem function, both of which should ideally be addressed in their framework. To remedy, the authors could define R_{out} in Eq. 2 as river runoff. The R_{out} term can then be unpacked as follows: $R_{out} = R_e + R_{oth}$ Where R_e is a term for ecological river flows and R_{oth} is what remains after ecosystem needs and human needs have been accounted for. Rather than explaining R_e as runoff to the sea, suggesting it holds little or no benefit to the river basin, the authors may state that this quantity must be maintained at specified values through the water year to support ecosystem services,

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in quantities determined through environmental flows assessment in accordance with the natural flow regime of the river basin. 12. Figures 3a and b are redundant. 13. Figure 3d- label reservoir storage to avoid confusion with soil storage. See comment 8 above. 14. What does the analysis of ecological vs. social ET/GPP provide that a land use analysis could not have provided? What is the additional information provided in the water balance approach? 15. The authors may strengthen their claim that the proposed water balance may be a tool for future sustainable water management in basins by suggesting how managers may approach determining acceptable thresholds/balance between ecological and social water needs. This may be sourced from prior ecological study indicating thresholds or tipping points in land conversion or water abstraction and ecosystem quality. Technical corrections: 16. There are many grammatical errors, in tense and syntax. Thorough copy-editing by a native speaker is necessary to eliminate all such errors. 17. Figure 2a and b: lines are difficult to distinguish, esp. R_{out} , G , and dS/dt . Moving the x-axis labels lower and using more distinct colors will help. 18. There is much redundant information in figures. Figure 5 summarizes much information from Figures 3 and 4.

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