

Referee comments are shown in black. Our responses in yellow.

RC2: 'Comment on hess-2023-255', Anonymous Referee #2

The authors have done a nice job of incorporating the new model evaluation results. I think that the results of this evaluation could be shown in the main text, highlighting where MEDFATE and the other two products differ. This is done in the text, but having the support of maps showing these differences would be ideal, in my opinion.

I also think that the discussion should consider the fact that a fraction of green water is not simulated by MEDFATE (understorey transpiration and interception). It should be clear then that the green water simulated by MEDFATE would be an underestimate.

The text has improved, but there are still some clarity issues that need to be addressed (see my specific comments).

Thank you very much for your positive comments. We explained in the R23 that we included the understory shrubs in the models.

#### Specific comments

P. 1. L. 15. Using '(relative) blue water flow' and '(relative) green water flow' sounds better to me. For example: 'We calculated blue water and green water flows and expressed them relative to received precipitation. Relative blue water flow was mainly concentrated...'. This sentence is also an example of improved clarity by removing superfluous text ('The results showed...') and can be applied in other instances of the manuscript.

R1. Done.

P. 1., L. 20. You're reporting water flows, not water content. Also, LAI has units ( $m^2$ ).

R2. Done.

P. 1. L. 22-24. The final sentence of the abstract should be revised. First of all, it's unclear what "decoupling" means here. Second, please check for grammar.

R3. We changed the sentence: "This study highlights how green water is decoupled from blue water, namely, blue water depends on winter and autumn precipitation, while green water depends on the spring and summer water demand."

L. 28. 'humanity', remove 'the'. Please use some grammar checker to detect grammar issues (not only spellcheck) throughout the ms.

R4. Done.

L. 28-31. The statement that the water cycle is more complex to study is not very convincing, given that photosynthesis, and respiration include way more processes. The reference supporting this statement is a general ecology textbook; there are probably better references to support the relevance of water availability for vegetation water functioning. For example:

Wang-Erlandsson, L., Tobian, A., van der Ent, R. J., Fetzer, I., te Wierik, S., Porkka, M., Staal, A., Jaramillo, F., Dahlmann, H., Singh, C., Greve, P., Gerten, D., Keys, P. W., Gleeson, T., Cornell, S. E., Steffen, W., Bai, X., & Rockström, J. (2022). A

planetary boundary for green water. Nature Reviews Earth & Environment, 1–13.  
<https://doi.org/10.1038/s43017-022-00287-8>

R5. We changed the sentence: “the water cycle is particularly challenging to study because of the difficult to measure its components. ”

L. 47. Again, I would treat green and blue water as flows, not content or amount.

R6. Done.

L. 46-51. From your earlier text, green water includes intercepted water and soil evaporation but in this part, you assimilate ‘green water’ to ET (Oki & Kanae) or T only (Schlesinger and Jasechko). Please align your statements with the correct references.

R7. The referenced values of green water/water flow are derived from Table 1 by Schlesinger and Jasechko. Although this work is focused in the T/ET we have calculated the ratio of ET/Precipitation according to the values of their table.

L. 52. The ‘trade-off’ or simply the ‘partitioning’?

R8. We change to partitioning.

L. 27-65. Is this a single paragraph? This should be split in 2-3 paragraphs, I think.

R9. We divided the paragraph in two.

L. 66-91. Again, is this a single paragraph?

R10. We divided the paragraph in two.

L. 71-72. Check the end of the sentence: “understand water fluxes at bigger scales than only with field data”. What does this mean?

R11. We changed the sentence: “Ecohydrological simulations have been shown as a valuable tool to understand water fluxes at different spatial scales, complementing the limited field data available (Hoek van Dijke et al., 2022; Mastrotheodoros et al., 2020).”

L. 73. “The stand structure variables have been studied”. Do you mean ‘the influence of stand structure on blue/green water partitioning’?

R12. Yes, we changed the sentence: “The effect of stand structure variables on water flow have been studied at local scale with field data”

L. 91. This trade-off needs to clearly emerge from the previous text in the introduction. Why a trade-off? This concept appears repeatedly towards the end of the introduction but it’s not clear how it’s addressed in the paper. It seems to me that this ‘trade-off’ is defined from a human perspective (forests use water that otherwise would flow in streams and recharge groundwater). I don’t think this is the aim of the paper so I would remove the ‘trade-off’ concept from the ms.

R13. Yes, we expressed the trade-off from a perspective of green vs blue water. We worked with relative values and we thought that can be correct the term. However, in the context of this work maybe it is not the most correct term. We removed the word by "partitioning" along the text.

L. 88-89. Here, for example, it's not clear why you write "Which are the spatio-temporal patterns of the trade-off between blue and green water along the Spanish Peninsula and among climate subregions? instead of ""Which are the spatio-temporal patterns of blue and green water flows...""?

R14. We removed trade-off of the sentence for improving the text.

L. 175-180. Wouldn't it be clearer then that parameters  $a_{Tmax}$  and  $b_{Tmax}$  also had a subindex 'i'? Also, how are these parameters obtained?

R15. We simplified the sentence and  $a_{Tmax}$  and  $b_{Tmax}$  are described in De Cáceres et al., 2023 (we included the reference in the sentence).

L. 180. Has SWR been defined?

R16. We changed to the full word, shortwave radiation.

L. 183. This seems a bit repetitive compared to the last sentence.

R17. We removed the sentence.

L. 220-242. The evaluation exercise is a nice addition to the paper and I think that the results could be briefly showcased in the main text, rather than in the supplement only. I would suggest showing maps with the difference between MEDFATE and SIMPAT and MEDFATE and GLEAM; these maps could be easily added as panels to Fig. 1. Moreover, in Fig S4/S5 I think that you could unify the colour scales, also making them similar to Fig 1.

R18. We think that the Figure 1 is very big and the Figure S4-S5 explained different things. We prefer to maintain the Figure S4-5 in the annex.

L. 261 - 263. As I understand, plot basal area is the sum of individual trunk cross-sectional areas, not diameters, right?

R19. Yes, it is correct. We used the dbh from forest inventory for calculating the trunk cross-sectional. We changed the sentence: "it is calculated by summing the trunk cross-sectional area at breast height of all trees per hectare"

L. 274. Please explain in the main text, not only in the reply, how R2 was estimated. Figure 1 is cropped on its lower side, at least in my pdf version.

R20. We included the explanation in the text.

L. 288. 'higher percentage of plots', or simply 'more plots'?

R21. It is “higher percentage of plots”. In the Table S3 (referenced in the text) is explained.

L. 284-290. In this text you use at least two different criteria to refer to high % of blue water: >50% (L. 286), >30% (L. 289). Please use a uniform criterion.

Fig. 6. Why do Mediterranean deciduous and temperate deciduous stands show such distinct relationships with winter precipitation?

R22. The first is referenced to the values of Figure 1B. We expressed the % of the map. The second is the % of plots from Table S3: “The Arid and Continental Mediterranean biomes showed a very large percentage of plots (> 70 %) with low relative blue water (< 15 %), whereas the Atlantic and Alpine biomes showed higher plots (> 50 %) with high blue water (> 30 %) (Table S3)”.

L. 408-411. At some point you should discuss that, especially in these cases, your modelled estimates will tend to underestimate green water because you’re not considering the contribution from understorey, either grasses or shrubs. See for example:

Perez-Priego, O., El-Madany, T. S., Migliavacca, M., Kowalski, A. S., Jung, M., Carrara, A., Kolle, O., Martín, M. P., Pacheco-Labrador, J., Moreno, G., and Reichstein, M.: Evaluation of eddy covariance latent heat fluxes with independent lysimeter and sapflow estimates in a Mediterranean savannah ecosystem, *Agricultural and Forest Meteorology*, 236, 87–99, <https://doi.org/10.1016/j.agrformet.2017.01.009>, 2017.

R23. MEDFATE simulates green water including the trees and understory layer, shrubs and herbaceous layer. We do not have data of herbaceous layer in the forest inventory but we included the shrubs species. We did the reference in the text: L122 “Moreover, the shrub species or genus within the 10-m-radius subplot were measured with their corresponding percent cover values.”. Table S2 includes the LAI S = Shrub LAI. Nevertheless, we did not do more referenced to the shrubs in the text. We include more information: L267 “LAI determine the transpiration of the trees and shrubs through of the leaf surface. LAI of the plot was calculated from the sum of the LAI of trees and shrubs”

L. 431. I don’t understand why you keep referring to the study by Ungar when you seem to refer to your results.

R24. Ungar realized their work with Mediterranean coniferous and the green water was very high. We cited the work because we obtained the similar results.

L. 433. ‘Having’ blue water sounds awkward, and you use this expression throughout the paper. Maybe ‘generate’ or ‘produce’ blue/green water?

R25. We only use “having” in the L153: “The soil is represented by vertical layers having different hydraulic properties...”

L. 425. Balance of which two fluxes? This is unclear...

R26. Because the blue water is affected by the green water, but we removed this part for avoiding confusion.

L. 436.-438. Here you're referring to transpiration (water use strategy of the species, not including other evaporative fluxes) only, not ET. On the difference between deciduous and evergreens maybe you could cite here Baldocchi et al 2010 (cited already in your ms)

R27. We changed to transpiration and we included the reference suggested.

L. 458-462. I think you need to discuss the influence on these results of the potential underestimation of green water by neglecting contributions from understorey in relatively open forests in general, both in terms of transpiration and interception (Balandier et al 2022).

Balandier, P., Gobin, R., Prévosto, B., and Korboulewsky, N.: The contribution of understorey vegetation to ecosystem evapotranspiration in boreal and temperate forests: a literature review and analysis, *Eur J Forest Res*, 141, 979–997, <https://doi.org/10.1007/s10342-022-01505-0>, 2022.

R28. We explained in R23 that shrub transpiration is included in the simulations.

L. 492. The 'limitations' section is a bit incomplete, in my opinion. What about the lack of understorey contributions to green water I have mentioned before? What would be the next steps concerning model evaluation, which you mention? Using compilations of eddy flux, sap flow data, lysimeters or catchment water balance? Would you expect improvements if using the advanced water balance model within MEDFATE (De Cáceres et al 2023) at these larger scales?

R29. We explained in R23 that we included the understory in the simulations. We included a reference to field data of eddy flux and sap flow data for the validation in the paragraph.

L. 509-510. Stand structure and functional composition are entered into the model through its parameterisation, so why is this role highlighted here?

R30. We agree with the reviewer that it is not necessary, we have removed the sentence.