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Hydrology and Earth System Sciences
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Discussions



# *Interactive comment on* "Technical note: Accounting for snow in the estimation of root-zone water storage capacity from precipitation and evapotranspiration fluxes" *by* David N. Dralle et al.

**Anonymous Referee #3**

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### General comments

The manuscript by Dralle et al. aims to account for moisture availability in snow-dominated catchments due to snow-melting and sublimation processes by modifying the Wang-Erlandsson et al. (2016) root-zone storage capacity ($S_r$) framework. The modified framework aims to provide a more conservative $S_r$ estimate in snow-dominated catchments and is analyzed at a much finer-resolution of 1km for Southern Sierra Nevada, CA, USA.

The modification to the original framework addresses an important aspect: excess moisture availability in snow-dominated catchments, which can influence moisture



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availability in a warmer climate. The manuscript is generally well written and the open access approach is laudable. However, I do have some major concerns:

- While it is clear that the modified framework provides a more conservative $S_r$ estimate (i.e., lower bound), the manuscript does *not* provide evidence that modifications also yield more accurate estimates. However, in several places in the manuscript (e.g., P6L129), it is implied that the new estimate is also more accurate. Ideally, I would suggest that the authors provide validation through e.g., hydrological modelling (with and without modified $S_r$) and validation against observation-based evaporation data or gauged runoff data. However, if providing such evidence is not within the scope of Technical notes, I would suggest that the authors make it clearer in the manuscript that there is no evidence at this point that the more conservative estimate is also more accurate.

- The term "conservative" may be confusing, as a low $S_r$ might be more conservative in certain applications (e.g., flood prediction) and less conservative in others (e.g., ecosystem service valuation of drought buffering capacity). Simply sticking to the terms like "lower-bound" or "minimum" would be less ambiguous.

- Ignoring horizontal inter-pixel flows (leakage and runoff) following Wang-Erlandsson et al. 's (2016) methodology (implemented globally at 0.5 degree resolution) at a 1km resolution for the present 'high elevation' study area can be problematic and non-conservative. Dralle et al., states (P2L46-49) that leakage and runoff are ignored, which "results in a conservative estimate of $S_r$". However, while this is true for high-elevation pixels, low-elevation pixels can expect an underestimation of $F_{in}$, and hence an overestimation of $S_r$. It is not clear to me if and how the authors address this, please clarify.

- The authors exclude the interception evaporation term from $F_{out}$ (L86), but uses total precipitation (rather than effective precipitation) for $F_{in}$. If interception evap-





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oration is excluded, it would make sense to also exclude the non-effective precipitation, which does not interfere with sub-surface processes. While it makes $S_r$ estimates lower, it might not be for the right reasons. Or do the authors by the phrase "interception is not included" mean that both interception and non-effective precipitation are removed? If that is the case, the sentence formulation needs to be less ambiguous, especially as the term "interception" comes directly after "transpiration" and "soil evaporation".

- A suggestion for a better overview could be to introduce a table with two columns for "before" and "after" your modifications: i.e., the first column lists the Wang-Erlandsson et al original equations, and the second column lists the modified version. You could list all differences in this table, incl. for example resolution, and definitions of $F_{out}$.
- In general, it would be helpful if the authors could more systematically describe when and how the water balance is violated.

**Specific comments**

L28: '...plant-accessible water below the soil'. Does this include groundwater? Please be specific.

L49: "$F_{in}$ and $F_{out}$ are set equal to precipitation (P) and evapotranspiration (ET), respectively". However, later at L86, it is stated that "interception is not included". This can be confusing as interception evaporation generally is considered part of ET. To minimize confusion, please consider defining the $F_{in}$ and $F_{out}$ clearly once and then consistently throughout.

L53,57: 'n' for Eq. 1 and 2 are not mentioned for the $S_r$ calculation. Is the simulation run for the whole term (2003-2017), or is it simulated annually?

L55: ‘root-zone storage deficit’. Suggest be consistent in terminology with Wang-Erlandsson et al., 2016.

L83: Dralle et al. have used PML-v2 evaporation product, which does a lot of plant function type (PFT) parameterization in evaporation calculation, leading to biome-based assumptions. Though, we believe that at such a fine-resolution, it shouldn’t matter much. However, it would add robustness to the framework if a sensitivity analysis using a different evaporation product (e.g., FLUXCOM) can be done using the modified framework. (I would recommend this for normal articles, but acknowledge that I am not sure about the scope of "Technical notes" - maybe the editor can help provide some guidance here.)

L89-90. What is the rationale for $C_0$ = 10 %? Is $C_0$ resolution/scale/context dependent? What are your recommendations for users attempting to apply the modified algorithm on a dataset with different topography, climate, and resolution? Furthermore, the statement ‘$C_0$ = 10% is also the resolution of the underlying snow cover dataset’ is unclear.

L110: What does $S_{max}$represent, since it hasn’t been mentioned before? What is a low-energy location? Please be more descriptive.

Fig 2. Evapotranspiration is referred to as $F_{in}$, instead of $F_{out}$.

Please be consistent with the notations for ‘Root-zone water storage capacity’ ($S_r$ or $S_r$[L] or $S_{max}$).

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