

Hydrol. Earth Syst. Sci. Discuss., referee comment RC2
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Comment on hess-2022-332

Anonymous Referee #2

Referee comment on "Assimilation of airborne gamma observations provides utility for snow estimation in forested environments" by Eunsang Cho et al., Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2022-332-RC2>, 2022

Review of "Assimilation of airborne gamma observations provides utility for snow estimation in forested environments" by Cho et al.

SUMMARY:

Overall, I think this paper is relevant for publication in HESS with a clear presentation. This paper leverages airborne gamma observations to estimate snow water equivalent using data assimilation. This is great work for the snow community that shows the potential of remote-sensed gamma observations to improve snow estimates. That said, clarification of how localization is implemented with DA would be helpful for others to repeat your work and interpolate the results.

Line-by-line comments:

- L125: For Equations (1) to (4), make sure to use the same format for the uncollided gamma count rates (e.g., $40K_b$ $^{40}K_b$).
- L138: From my understanding, COOP snow depth is first converted to SWE which is assimilated (rather than snow depth) to get UA SWE. Please make sure this sentence won't cause any confusion.
- L186: For MERRA2, are bias-corrected precipitation or uncorrected precipitation used as inputs? In line 308, the authors mention that overestimated SWE is likely attributed to precipitation phase partition. Would bias from precipitation contribute to the overestimation?
- L196: Could you briefly summarize how Kwon et al. (2021) perturbs the forcings? For example, which forcings are perturbed? How are the parameters chosen? (i.e., Were in situ observations used to quantify these parameters?) This would be helpful to know if precipitation uncertainties are considered.

- L215: It is not clear to me how localization is applied in the assimilation. Does it weigh the covariance matrix? It might be better to link equation (7) with the relevant equation mentioned above. I might not fully understand it, but why localization used to update SWE estimates would impact the open loop results shown in figure 6? I assume localization would only impact DA SWE.
- L226: maybe use lowercase "a" in the parenthesis.
- L236: it seems peak SWE might not be correctly estimated if only one data point exists after the accumulation season (Figure 4 SJ150 in WY 1989 and NH106 in WY 1997). It might be worth pointing that out and/or discussing this issue.
- Please be consistent with either RMSD or RMSE throughout the manuscript.