We thank the reviewer for these helpful comments. Reviewer comments are listed below, along with our response to each. In some cases, we describe the proposed revisions to the manuscript (with line numbers) or refer to proposed revisions described in our responses to the other reviewers, but we recognize that the revised manuscript is requested in a subsequent step.

Comment 1:

This manuscript analytically derived both forms of the parametric Budyko equations, producing expressions for n and w only in terms of long-term mean P, E0 and E.

Response 1:

To clarify, our manuscript does not derive both forms of the parametric Budyko equations. Rather, we analytically inverted the existing two parametric Budyko equations, producing expressions for *n* and *w* in terms of precipitation, evapotranspiration, and potential evapotranspiration.

Comment 2:

This derivation is logically sound, but the expressions for n and w are too complex to apply for estimating the values of n and w.

Response 2:

We agree that the full solutions are complex, however, in the context of advancing our understanding of *n* and *w*, the degree of their complexity is largely irrelevant since they are the only extant explicit expressions for *n* and *w*. Therefore, they are currently the only way to estimate *n* and *w* explicitly as well as being the only way to directly relate *n* and *w* to biophysical features through $\bar{P}$, $\overline{E_0}$, and $\bar{E}$. Prior to the development of these explicit expressions, *n* and *w* could only be determined from $\bar{P}$, $\overline{E_0}$, and $\bar{E}$ by numerically solving the parametric Budyko equations. It is plausible that the expressions presented could be simplified to a “less complex” form or that a simpler analytical inversion could be developed, however, until such events occur, these expressions are the simplest (and only) explicit expressions for *n* and *w*.

We acknowledge the reviewer’s point that when directly computing *n* and *w* from values of $\bar{P}$, $\overline{E_0}$, and $\bar{E}$, the explicit expressions we derived do not offer a significant advantage over the standard numerical inversion method, since in practice both methods must implemented with computational algorithms. However, the direct computation of *n* and *w* is not the primary utility of the explicit expressions. Rather, they illustrate that the dependence of *n* and *w* on any “hidden” biophysical processes must be through the dependence of $\bar{P}$, $\overline{E_0}$, and $\bar{E}$ on those same features and processes, thus advancing our understanding of the parametric Budyko equations (as well as limitations to their utility). The direct dependence of *n* and *w* on $\bar{P}$, $\overline{E_0}$, and $\bar{E}$ is explored in detail in the companion research article (Reaver et al., 2020) (hess-2020-584, Reinterpreting the Budyko Framework, cited on page 3, line 57), however, this point could be more clearly articulated in this technical note. We thus propose revisions to the abstract, introduction, and discussion and conclusions sections to better motivate the study and summarize our interpretations regarding the utility of catchment-specific parameters and the overall parametric approach. These proposed revisions are given in our response to **Reviewer 1, Comment 3.**

Comment 3:

This paper lacks rationality analysis of n and w expressions. It is necessary to analyze the rationality of the results using the observation data in some watersheds with different climate and biophysical features.

Response 3:

It is unclear what the reviewer is referring to when requesting a “rationality analysis”, nor why it is necessary or relevant to this technical note. As we note in the manuscript, the primary aim of this technical note was to analytically invert the parametric Budyko equations and verify that the derived solutions were valid by comparison to numerical inversion. Thus, it is not clear how observational data from real catchments would be incorporated into the current scope of the manuscript. While it is possible to take observational data (e.g., $\bar{P}$, $\overline{E_0}$, and $\bar{E}$) from different catchments to estimate *n* or *w* (using Equation 14) and compare them with the numerical solution of the implicit parametric Budyko equations (Equations 4, 5, 6, and 7), the same approach can be applied to any selected values of $\bar{P}$, $\overline{E_0}$, and $\bar{E}_0$ (as was done in the manuscript; Figures 1-4, pages 6-8, lines 124-155). Importantly, the source of the values for $\bar{P}$, $\overline{E_0}$, and $\bar{E}$ (e.g., computed from observational data or chosen) is not important for verifying the explicit expressions

Comment 4:

The expressions derived in this paper are only suitable for natural watersheds or for the analysis of climate-vegetation-hydrology equilibrium. However, it can not be used to estimate the impact of land use changes or vegetation changes due to human activities on the water balance of watersheds.

Response 4:

The assertion that the derived expressions for *n* and *w* are only suitable for natural watersheds or for the analysis of climate-vegetation-hydrology equilibrium is both unsubstantiated and incorrect. Equation 14 (page 4, line 85) allows one to explicitly estimate the value of *n* or *w* for set of $\bar{P}$, $\overline{E_0}$, and $\bar{E}$ values no matter what the source of those values is (e.g., human-impacted watershed, chosen at random, natural watershed, etc.). We agree that the explicit expression for *n* and *w* cannot be used to estimate the impact of anthropogenic land use change on the catchment water balance, however this was not the goal of the manuscript, nor a claim that we made. Rather, we stated that Equation 14 (page 4, line 85) provides the “general expression for the dependence of n and w on any possible biophysical features through the dependence of $\bar{P}$, $\overline{E_0}$, and $\bar{E}$ on those same features” (page 3, lines 65-66). In the companion research article (Reaver et al., 2020), we specifically state that the parametric Budyko framework generally cannot be used to estimate the impacts of anthropogenic land use change on the catchment water balance.

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