1 Based on Reviewer 1 remarks, we made the following changes:

- In the list of previous studies (section 1.2), we added a mention to the paper of Sankarasubramanian et al.:

"This dependency was emphasized by Koster and Suarez (1999), who write that "the partitioning of a precipitation anomaly into evaporation and runoff anomalies is a simple function of the dryness index", by Sankarasubramanian et al. (2001) who argue that empirical elasticity estimates would only follow the direction shown by the Budyko-type formulas for the very humid regions of the US, while Arora (2002) concludes that "the use of aridity index provides a straight-forward method to obtain a first order estimate of the effect of climate change on annual runoff"."

- We added Figure 4 in section 3.3:

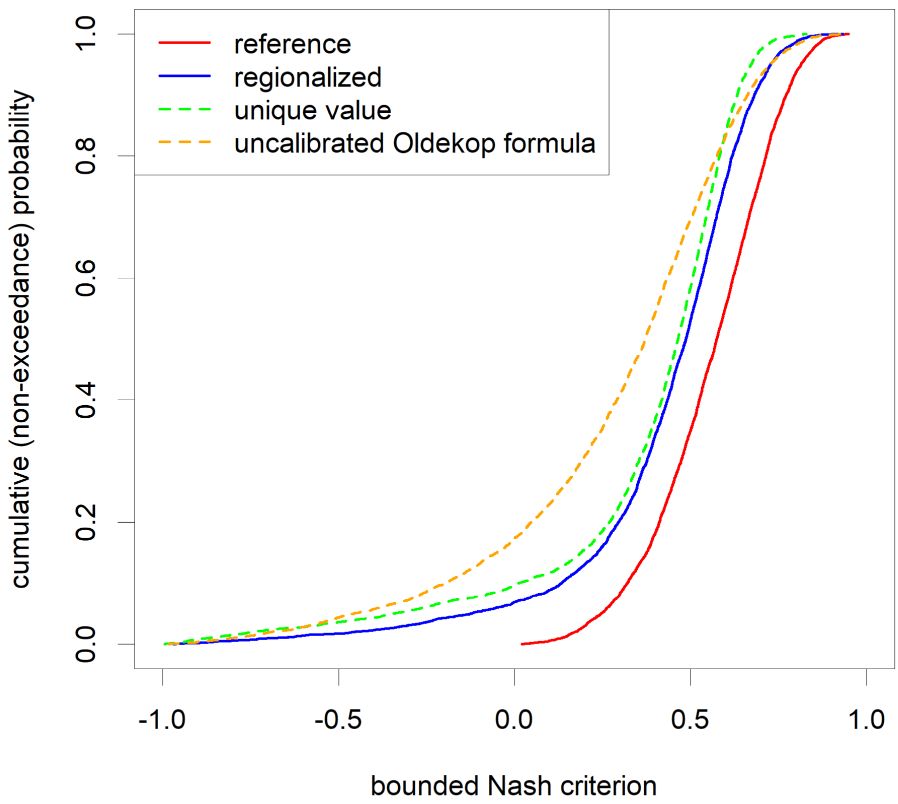

Figure 1. distribution of the performances of the options compared in our paper, with in addition the uncalibrated theoretical formulation derived from the Oldekop formula. The (unreachable) upper reference at the extreme right is followed by our regionalized solution, which has a better performance than an elasticity formula with a unique value (that would be independent from aridity) or than the elasticities derived from the (uncalibrated) Oldekop formula.

- In section 4.1, we explained what we considered to be "mixed results":

"Thus, we argue that the elasticity-aridity link cannot be taken for granted and requires empirical verification, especially given the mixed results reported by Oudin and Lalonde (2023), who tested the classical space-time trading when parametrizing a land use dependent hydrological model, which failed to efficiently predict the direction and magnitude of hydrological changes after land use conversions."

- In section 5.2, we explained the reason why we consider that the simple elasticity model used in this paper is only adapted to catchments which lack long memory:

"First, the relationships in Table 5 were developed on catchments with limited interannual memory (in the sense of de Lavenne et al., 2022): this excludes those catchments for which Eq. 3 would not be warranted to estimate streamflow elasticity, since additional independent variables expressing the climatic anomalies of the previous years would have been required (note that we could have done following the work by de Lavenne et al., 2022, or that of Pelletier and Andréassian, 2020, but we preferred to keep the estimation of the elasticities as simple as possible)."

2 Based on Reviewer 2 remarks, we made the following changes:

- We added the following reference in section 1.2:

"Let us however mention that Addor et al. (2018), using random forests to explain (among others) the precipitation elasticity of streamflow, concluded that signatures of "hydrological dynamics are poorly predicted by aridity alone, or even by a combination

of several climatic indices"."

- We added the following explanation in section 1.4:

"These bounds represent a physically-realistic catchment response, in the sense that the yield (of the additional mm of precipitation or the additional mm of potential evaporation) must be comprised (in absolute value) between 0 and 100% in the sense that the yield (of the additional mm of precipitation or the additional mm of potential evaporation) must be comprised (in absolute value) between 0 and 100%."

- We added the following comment (and reference) in section 4.2:

"Concerning the difference between the elasticities derived from the theoretical Budyko-type formulas and the empirical class-calibrated values, we can suggest two explanations: first, a Budyko-type formula will always remain a conjecture (elegant, mathematically relevant conjecture… but a conjecture); second, Gnann et al. (2026) have shown that realistic observational noise will introduce systematic departures from the theoretical optimum."

- We added the following limit in section 5.2:

"Third, although we authors strongly believe that aridity is the first-order driver of elasticity at the global scale, it is not the only one, and our regional model is clearly only a first step in the search for physical explanations."

- We added the following statement on collinearity in section 2.2:

Note that the correlation between the independent variables of the regression presented in **Erreur ! Source du renvoi introuvable.** is rather limited: the correlations computed at the catchment scale are comprised for 90% of the cases in the range [-0.6,0.2] for $(\Delta P_n, \Delta E_{0_n})$, in the range [-0.7,0.5] for $(\Delta P_n, \Delta \Lambda_n)$, and in the range [-0.5,0.4] for $\Delta E_{0_n}, \Delta \Lambda_n)$,

- In section 2.3, we added a short description of the grid search algorithm:

"Estimating a single triplet of elasticities for each class allows investigating the dependency of elasticity to aridity. To calibrate the three parameters, we use a simple grid search algorithm, exploring the following intervals: [-0.1,1.1] for $e^{cl}_{Q/P}$, and [-1.1,0.1] for e^{cl}_{Q/E_0} and $e^{cl}_{Q/\Lambda}$, first with a coarse step of 0.1 and then a finer step of 0.01 around the optimum."

- In section 2.1 we added a short description of the hydrologic memory filter:

"Let us just mention that we excluded a few catchments with a long memory, for which the linear elasticity model presented in Eq. 16 would not have been justified (indeed, if a catchment has a hydrogeology that provides him long memory, the elasticity cannot be expressed a function of current year climate, but should be estimated by accounting for as many previous years as needed. The absence of interannual memory guarantees the lack of autocorrelation in annual streamflow, which is an important statistical assumption for OLS."

3 Added references

Addor, N., Nearing, G., Prieto, C., Newman, A. J., Le Vine, N., & Clark, M. P. (2018). A Ranking of Hydrological Signatures Based on Their Predictability in Space. Water Resources Research, 54(11), 8792–8812. https://doi.org/10.1029/2018WR022606

Gnann, S., Anderson, B. J., and Weiler, M.: Uncertainty and non-stationarity of empirical streamflow sensitivities, EGUsphere [preprint], https://doi.org/10.5194/egusphere-2025-4527, 2026.