Dear Reviewer,

Thank you for reviewing our paper and for your encouraging remarks. We will address them all in the revised version. In this answer, we will only address the central remark of your review, i.e. that pertaining to the choice of the synchronicity index. We first discuss the new solution that we propose, and then analyze your suggestion (which we found to be linearily corrected to one of the alternatives presented in the appendix of the paper).

1. Renaming our new synchronicity index or proposing a new one

First of all, we agree with your computations, which clearly identify the actual behaviour of our present synchronicity index. The definition we gave ("*λ_n represents the percentage of annual precipitation that is the most easily accessible to evaporation"*) is approximative, and the examples you gave show it. It comes from the difficulty to describe with words the two members of the ratio: while it is easy to write that the numerator $\sum_{m=1}^{12}\left(P_{m,n} \cap E_{0_{m,n}}\right)$ represents the quantity of precipitation that is the most accessible to evaporation, the denominator $\sum_{m=1}^{12}\left(P_{m,n} \cup E_{0_{m,n}}\right)$ is a kind of "super-potential evaporation", i.e. the potential evaporation that would occur if there was always water available when there is energy available for evaporation AND if there was always energy available when there is water available. We honestly recognize that this concept is not completely easy to understand… and we agree on the need to be able to explain clearly with words what our index does. This is why we propose a new formulation below.

First, let us remind that we initially wished to use exclusively the amount of synchronous P and E_0 (in mm/yr) in the regression equation (and in fact, this is what yielded the best results in terms of R^2):

$$synchronous\ P - E_0\ amount = \sum_{m=1}^{12}\left(P_{m,n} \cap E_{0_{m,n}}\right)$$

Unfortunately, this amount is highly correlated with the annual precipitation sum (and it is not good practice to have correlated independent variables in a regression equation). While this was not a problem for most of the catchments in our dataset, we wanted to avoid it. Moreover; in terms of graphical representation, this positive correlation of $\sum_{m=1}^{12}\left(P_{m,n} \cap E_{0_{m,n}}\right)$ with P_n hides the fact that more synchronicity tends to reduce streamflow.

As you noticed, we mentioned in the appendix of the paper some alternatives indices. But we forgot one. If we look for a straightforward interpretation, there are two main alternatives:

- $Alt_1 = \frac{\sum_{m=1}^{12}\left(P_{m,n} \cap E_{0_{m,n}}\right)}{P_n}$ represents the proportion of annual precipitation which is the most accessible to potential evaporation ($0 \leq Alt_1 \leq 1$). We mention this alternative in the appendix (Eq.6);
- $Alt_2 = \frac{\sum_{m=1}^{12}\left(P_{m,n} \cap E_{0_{m,n}}\right)}{E_{0_n}}$ represents the proportion of annual potential evaporation which is the most accessible to precipitation ($0 \leq Alt_2 \leq 1$). This is the alternative we forgot to mention.

Returning to the two examples that you mention in your review, the first one (*P = 5 mm every month and PET = 40 mm every month*) would result in Alt_1 = 1 and Alt_2 = 0.125; which corresponds to your comment (100% of the precipitation is easily accessible to evaporation). Your second example would result in $Alt_1 = 0.125$ and $Alt_2 = 1$, which corresponds to your comment (most of the precipitation is inaccessible to evaporation).

Using the two indices separately is a possibility, but it makes things less simple and straightforward. Using only Alt_1 in the regression is possible, but the problem of the graphical representation remains (the correlation between annual precipitation amounts and Alt_1 hides the effect we want to show). Using only Alt_2 in the regression is possible, it solves the problem of the graphical representation, but because the annual values of potential evaporation are not very variable, we find ourselves again with two correlated explanatory variables in the regression.

We thought that it would be possible to combine both indices into one:

$$New\ \Lambda = Alt_1 * \bar{P} + Alt_2 * \overline{E_0} = \frac{\sum_{m=1}^{12}\left(P_{m,n} \cap E_{0_{m,n}}\right)}{P_n} * \bar{P} + \frac{\sum_{m=1}^{12}\left(P_{m,n} \cap E_{0_{m,n}}\right)}{E_{0_n}} * \overline{E_0}$$

This 'new lambda' would represent, in mm/yr, the sum of neutralizable precipitation and neutralizable potential evaporation. Any increase of the sum should favor evaporation over streamflow.

We tested this new lambda and found that it is able to explain the annual streamflow anomalies almost as well as the old one and it is visually as satisfying: we plot for example streamflow anomalies and synchronicity anomalies below (using all 4 122 catchments and all 162 005 station-years).

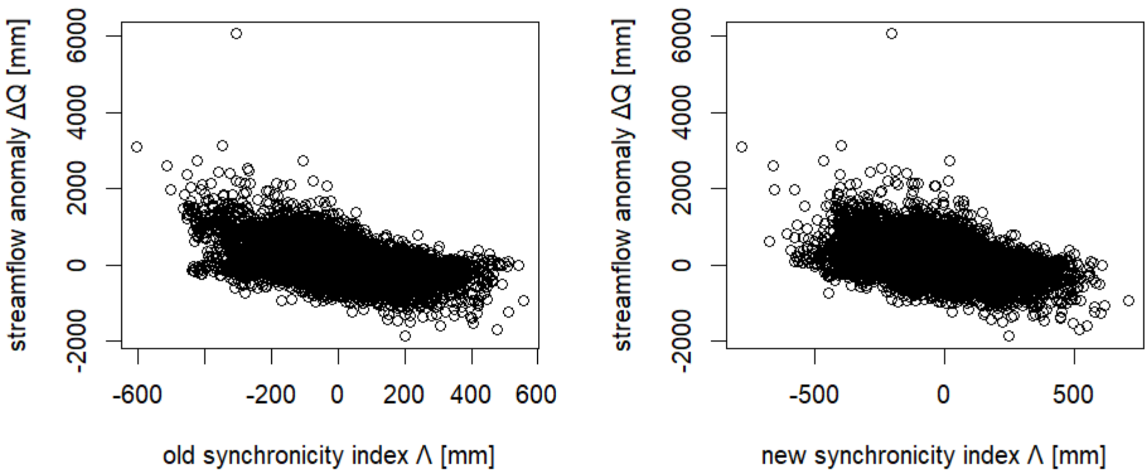

Figure 1 : graphical comparison of the old and the new synchronicity indices on the entire dataset

For all these reasons, we propose to modify the Λ in the revised version. If this new version is easier to explain and understand, we believe it is worth introducing it.

2. Analyzing your suggestion for a synchronicity index

Thank you very much for your recommendation (λ-New). We did implement it but found that it is in fact linearly correlated with Alt_1:

$$\frac{\sum_{m=1}^{12} max\left(P_{m,n} - E_{0_{m,n}}, 0\right)}{P_n} = 1 - \frac{\sum_{m=1}^{12}\left(P_{m,n} \cap E_{0_{m,n}}\right)}{P_n}$$

The demonstration is as follows:

$$\begin{aligned} P_n = \sum_{m/P_{m,n} > E_{0_{m,n}}} P_{m,n} + \sum_{m/P_{m,n} \leq E_{0_{m,n}}} P_{m,n} \\ &= \sum_{m\,/\,P_{m,n} > E_{0_{m,n}}} \left(P_{m,n} - E_{0_{m,n}} + E_{0_{m,n}}\right) + \sum_{m\,/\,P_{m,n} \leq E_{0_{m,n}}} P_{m,n} \\ &= \sum_{m\,/\,P_{m,n} > E_{0_{m,n}}} \left(P_{m,n} - E_{0_{m,n}}\right) + \sum_{m\,/\,P_{m,n} > E_{0_{m,n}}} E_{0_{m,n}} + \sum_{m\,/\,P_{m,n} \leq E_{0_{m,n}}} P_{m,n} \end{aligned}$$

Since

$$\sum_{m=1}^{12}\left(P_{m,n} \cap E_{0_{m,n}}\right) = \sum_{m\,/\,P_{m,n} > E_{0_{m,n}}} E_{0_{m,n}} + \sum_{m\,/\,P_{m,n} \leq E_{0_{m,n}}} P_{m,n}$$

And

$$\sum_{m\,/\,P_{m,n} > E_{0_{m,n}}} \left(P_{m,n} - E_{0_{m,n}}\right) = \sum_{m=1}^{12} max\left(P_{m,n} - E_{0_{m,n}}, 0\right)$$

We come to the above-mentioned conclusion.