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Hydrology and Earth System Sciences
Discussions

Interactive comment on "A Robust calibration/validation protocol of a hydrological model using hidden Markov states" *by* Etienne Guilpart et al.

Anonymous Referee #2

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The study applies the differential split-sample test to evaluate the robustness of hydrological model parameters using the HMM to identify sub-sequences of different hydroclimatic conditions. The approach is tested over three sub-basins of the Senegal River employing the GR2M model; the 2-states and 3-states HMM classifications are compared with the non parametric Pettitt's test which allows to detect a single change point. Authors state that results show that HMM can be a viable classification option for long time series exhibiting multiple change points.

There are several points that deserve further insights and that are not sufficiently explored in the study. 1) The title of the paper hints at a protocol of calibration/validation

of hydrological models that in my opinion is still substantially based on the differential split sample test proposed by Klemes (1986). The study rather focuses on the comparison of different approaches to identify sub-periods characterized by different climatic conditions. The 3steps protocol outlined at sec. 4 is not novel and should at least include calibration and validation steps. I suggest rephrasing the title.

2) I agree with remark in RC1 about the necessity of a more detailed analysis to support the climate classification sequence identified by the HMM in terms of changes in meteorological data or land use.

3) Results in Table 3 are too shortly discussed in Section 5. Although HMM allows for a finer labelling of each year, NSE and KGE coefficients in Table 3 do not show higher performance in fitting observed flows. Classification based on Pettitt's test provides comparable or better results, particularly for the Daka Saidou and Oualia basins. An interesting insight could be given on which is the most convenient case to apply to reach better performance (Case 1 vs Case 2; Case 3 vs Case 4;. . ..). The case study and the results do not allow a generalization of the approach and probably it is not the ideal test case to show the advantages of the proposed method mostly because there is a marked rupture in streamflow observations.

4) The content of the final paragraph at sect. 5.1 is not clear and differences (if any) with the traditional differential split sample test should be better outlined. Moreover, conclusions not always refer to by presented analysis and results showed in the study and do not seem to support statement in the abstract.

There are some other minor comments (see below) that I recommend to consider.

Table 1: Check isohyets ranging for the Bakel sub-basin.

Table 2: can be improved by associating parameters to dry, wet and nor period.

Figure 5b: I suggest to use the same axis limits for both validation and calibration performances.

Eq. (3): Check equation symbol (*)

Eq. (4, 5, 6): several symbols are not introduced or explained in text.

Line 205: should be T3HMMnor

Recent examples of differential split-sample validation tests that can be included as references have been reported in:

D.F. Motavitaab, R. Chowab, A. Guthkea, W. Nowaka. (2019). The comprehensive differential split-sample test: A stress-test for hydrological model robustness under climate variability, Journal of Hydrology, Volume 573, Pages 501-515

H. Dakhlaouiab, D. Ruellandc, Y.Tramblayd. (2019) A bootstrap-based differential split-sample test to assess the transferability of conceptual rainfall-runoff models under past and future climate variability, Journal of Hydrology, Volume 575, Pages 470-486

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