Hydrol. Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/hess-2019-6-RC1, 2019

Hydrology and Earth System Sciences
Discussions

Interactive comment on "Improving hydrological projection performance under contrasting climatic conditions using spatial coherence through a hierarchical Bayesian regression framework" *by* Zhengke Pan et al.

Anonymous Referee #1

Received and published: 22 February 2019

This paper analyzes the prediction performance of a lumped hydrological model using different time and spatial dependent parametrizations of one of its parameters.

There are several errors in the paper and points that should be explained better and I have a major concern regarding the results.

Comment on the results:

The value of omega looks strange to me. Assuming that the equation 1 you wrote is correct (and therefore it is a frequency and not a phase) and that the order of magnitude

of omega is of hundreds (like shown in figures 8 and 9), this mean that your parameter theta1 oscillates hundreds of times per time step. This looks unreal to me since the goal of having time-variant parameters is to represent long term (seasonal) oscillations. Therefore, either there is a problem with the unit of omega or your model is not doing what it was meant for. If omega is a phase (meaning theta1 = alpha + beta*sin(t + omega)) the value of omega makes more sense but theta1 would still complete an oscillations every 6.28 time steps (the time step is days, right?). Don't you also have a frequency that multiplies "t" and have a small value?

Detailed comments:

line 102-103: There is not a clear definition of pooling, complete pooling and hierarchical Bayesian. I would explain shortly what do they mean and which are the differences since then the paper only writes about hierarchical Bayesian.

line 152-153: It would be beneficial to explain shortly how the method works even if it was already used in other studies.

line 159: Maybe it is more appropriate to use "cross validation" instead. I suggest to avoid making a paragraph with just one sentence and remove paragraphs 2.1.1 and 2.1.2 putting all together in section 2.1.

chapter 2.3: It is not clear to me what do you do with the other parameters of the GR4J model (theta2, theta3, theta4). Do you keep them fixed or do you sample them? What is their effect on the final result?

line 199: The equation is different from the ones reported in Table 1.

line 201: You write that omega is the phase while in the equation 1 it is a frequency.

line 202: The combination alpha=beta=omega=0 makes theta 1 to be equal to 0, that indeed it is a constant value but probably it is not what you want.

chapter 2.3.2: What happens to alpha? You don't write about it anymore in the rest of

the paper. Do you keep it fixed or do you sample also it? What is its effect on the final result?

chapter 2.3.2: It is not clear to me if linking the parameters between catchments means sampling them from the same Gaussian distribution or there is another form of linking.

chapter 2.3.2: How do you sample omega and beta when they are not linked?

line 218: How do you choose the values of mu and sigma, the hyper-parameters of your model?

chapter 2.4.1: I wouldn't call "likelihood function" what actually is an objective function.

line 250: You are mixing an objective function with a prior distribution of the parameters. How do you account for the prior distribution of the parameters when they are not linked?

chapter 2.4.2: You don't say which settings of the sampling method you use (e.g. how many parameters you sample. . .)

chapter 3.2.1: The dataset that you get is unbalanced, since there are more wet years. Is it taken into account? Does it have an effect on the calibration?

chapter 3.2.3: Figures 7 and 8 are actually 8 and 9

Figures 5, 6, 8, 9: Since you want to show a probability distribution I wouldn't use a boxplot but, instead, I suggest to use a violin plot (e.g. https://seaborn.pydata.org/examples/grouped_violinplots.html)

Figures 8, 9: Why do you change the colors between beta and omega? This makes the plot more difficult to read.

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