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Interactive comment on "Using NDII pattern for a semi-distributed rainfall-runoff model in tropical nested catchments" *by* Nutchanart Sriwongsitanon et al.

Anonymous Referee #1

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I carefully read the paper titled ÂńUsing NDII pattern for a semi-distributed rainfall-runoff model in tropical nested catchments Âż, by Sriwongsitanon et al. This paper completes a previous paper by Sriwongsitanon et al., 2016, showing that NDII is correlated with the dynamics of the water level in the root zone reservoir of the FLEXL lumped model, suggesting that NDII could be used as a proxy of then water content for the one hand, and could improve the model performance for the other hand.

Here, the purpose is to assess the efficiency of FLEX-derived semi-distributed models based on distribution of the travel times (FLEX-SD) and on the distribution of both the travel times and the water storage in the root zone, according NDII spatial variability for

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the latter (FLEX-SD-NDII). The SD models were tested in several sub-catchments of a nearly 6.000 km2 catchment in Thailand, at a daily time step. The semi-distributed model URBS was also compared to FLEX-SD and FLEX-SD-NDII.

The method consists in calibrating all the models at the outlet of the larger catchment P.1, then in performing each model without calibration at the outlet of 5 sub-catchments. The lumped FLEX model was however calibrated in each sub-catchment in order to give a reference of goodness in each sub-catchment. Four error functions were considered : Nash-Sutcliffe Efficiency (NSE), Kling-Gupta Efficiencies (KGE) for high flows, low flows, and the flow duration.

Finally, the SD-FLEX models were found to perform correctly in the sub-catchments, without recalibration. NSE and KGE mean values over all the sub-catchments were respectively 0.74, 0.79, 0.66 and 0.84 for FLEX-SD, 0.74, 0.81, 0.66, 0.87 for FLEX-SD-NDII. In addition, the relationships between the 8-days NDII values and the water levels in the root zone reservoir (Su) are better for FLEX-SD-NDII than for FLEX-SD. So that FLEX-SD-NDII does not perform better than FLEX-SD in terms of accuracy of runoff estimates, but as the authors say, FLEX-SD-NDII " has gained realism and hence predictive power". It is also shown that the relationships between Su and NDII are poor during dry seasons, highlighting the limitation of NDII to be considered as a powerful proxy of the root zone water content. Auxiliary other results are that first, the FLEX-SD models perform better than the SD URBS model, and second, that the Su levels in the root zone reservoir are better correlated with the SWI index than with the NDII index.

My opinion is that the study shows interesting results which are worth to be published in the review. It could help for practicing widely used models like FLEX or URBS, and show the interest of semi-distributed models for reproducing internal flows within a given catchment. However, there is sometimes a lack of clarity, and the paper would gain in my sense by giving some more details. Although the paper is concise, well written and well structured, I feel that at least the general strategy and the main steps

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of the method should be reinforced and summarized earlier in the paper, in order that the reader could have a complete view of the construction as soon as the end of the introduction. In addition, some more information could be brought for the model calibration and the strategy for the comparison of the models. The gain due to the spatial variability of the rainfall itself did not seem to be discussed in the paper, although it could be a major benefit.

Introduction I would appreciate that the introduction would give a more comprehensive review of the NDII interest for hydrological modelling. What were the main results which obtained Sriwongsitanon et al., 2016, are there more studies dealing with using NDII in hydrological modelling, how this paper completes the previous one. . . . . .

In addition, the authors could summarize at the end of the introduction the main steps of the strategy they intend to develop in order to prove the interest of the SD models, for giving the reader a global view of the structure of the paper. I fell that I was discovering the method step by step while going on and reading the different sections of the paper.

Rainfall-Runoff data

4, 2-3 : The Royal Irrigation Department (RID) operates 7 daily runoff stations in the study area between 2003 and 2013 as shown in Fig. 1. Catchment P.56A was rejected from the study because it is located upstream of Mae Ngat reservoir.

Why is it a problem ?

4, 5-6 : The data have been checked for their accuracy by comparing them with average rainfall data covering their catchment areas at the same periods.

What were the test and the results of the test ?

Performing/calibrating the SD-models

Figure 1 shows the location of the 6 gauging stations, as well as the number and the boundaries of the 10 sub-catchments which were designed upstream of the gauging

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stations. So, 2 sub-catchments seemed have been considered upstream the gauging station P.4A, 2 upstream of P.20, 4 upstream of P75, 1 upstream of P21 . . .. This should be mentioned explicitly in the paper. Did the SD models actually run over several sub-catchments within a given sub-catchment : for example, did the SD models run over 2 sub-catchments upstream from P.4A, over 4 sub-catchments upstream from P.75, etc. . . In this case, how were selected the number and the area of the sub-catchments upstream of each gauging station? How is the model dependent of the number of sub-catchments, and could this dependence alter the interpretation of the performance of the SD-models?

3, 29-31 : These data have been validated for their accuracy on monthly basis using double mass curve and some inaccurate data were removed from the time series before spatially averaging using an inverse distance square (IDS) to be applied as the forcing data of URBS, FLEXL, and FLEX-SD.

I suppose that the mean areal rainfalls were calculated for each sub-catchment. That means that the gain of the SD-models could be due to take into account of the rainfall variability. Could the authors give some information about this variability? Furthermore, could they assess the effect of the distribution of the rainfall on the gain that bring the SD-models? For example, what would be the results of a semi-distributed FLEX model using only the spatial variability of the rainfall, and keeping the same TlagF and TlagS for all the sub-catchments.

Modelling results

9, 15-16 : Table 4 surprisingly shows that FLEX-SD and FLEX-SD-NDII provide better or equally good runoff estimates at P.1, P.67 and P.75 stations located along the main Ping River, compared to those provided by the calibrated FLEXL model.

This does not seem so surprising, at least for the P.1 gauging station, where all the models have been calibrated. In addition, the SD-models count with a higher number of parameters, which could allow higher scores in reproducing runoff characteristics

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when calibrating the models.

The correlation between NDII and the maximal storage capacity in the root zone appears to be poor in wet season. The R2 values were around 0.30-0.40 with the calibrated FLEX L model in the different sub-catchments. In the previous paper published in 2016, such values were higher, around 0.4-0.5 even more. Could the authors comment this difference ?

Table 4 : bold values are missing for P.1

Conclusion

11, 21-22 : “The lag time from storm to peak flow and the lag time of recharge from the root zone to the groundwater have been distributed among sub-catchments using their catchment areas and reach lengths.”

I think that the lag times are not from storm to peak flow, but from storm to runoff generation

The correlation between NDII and the maximal storage capacity in the root zone appears to be poor in wet season. The authors recognize that NDII cannot be considered as a reliable proxy of the soil water content. This should be recalled in the conclusion.

In conclusion, due to the scientific interest of the paper and the good value of the study, I recommend that the paper would be published in the review, after modifications which can be considered as minor revision.

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